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A GUIDE TO THE LITERATURE ON CERTAIN EFFECTS OF LIGHT ON FUNGI: REPRODUCTION, MORPHOLOGY, PIGMENTATION, AND PHOTOTROPIC PHENOMENA

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A GUIDE TO THE LITERATURE ON CERTAIN EFFECTS OF LIGHT ON FUNGI: REPRODUCTION, MORPHOLOGY, PIGMENTATION, AND PHOTOTROPIC PHENOMENA

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BACKGROUND

In the course of investigating the problem of pre-harvest microbial deterioration of cotton fiber, the writers noticed from accounts in the literature that isolates from three of the fungus genera which are most frequently involved in this problem -- Alternaria, Fusarium, and Diplodia -- are influenced in their sporulation in culture by light. Among the numerous fungi which grow upon the fiber in humid storage -- Aspergilli, Penicillia, Mucorales, and so forth -- some species also were reported to exhibit effects of light in respect to sporulation, or phototropic effects. Trichoderma, a fungus used in fundamental studies of fiber deterioration and in testing mildew resistance of textiles, also had been shown to be induced to sporulate by light.

While searching the literature for information on light effects on fungi important in microbial fiber deterioration, the writers observed that no general source of information on the effects of light on fungi was available. Consequently, over a period of time they built up a set of reference cards on this subject; the present literature guide is derived from these reference cards.

NATURE AND PURPOSE OF THE GUIDE

The literature references listed here are concerned principally with effects of light on reproductive, morphological, and phototropic phenomena among the fungi and with light effects on pigmentation. Lethal and mutagenic effects and effects observed with fungi growing on or in a living plant have been excluded. The information presented is arranged according to the fungus involved, the listings being alphabetical by genus under each of four main taxonomic categories -- Phycomycetes, Ascomycetes, Basidiomycetes, and Fungi Imperfecti.

In preparing the guide there has been no intention of trying to develop a critical review of experimental evidence nor of dealing in great detail with the physiological mechanism of light effects. Rather, the guide is intended principally for use by the individual who is working with a particular fungus or group of fungi and wishes to locate such information as may be available in the literature on formative and pigmentation effects of light on this organism or organisms. When an original author of a paper has claimed to have observed some influence of light on a fungus which he has investigated, such information has generally been included here independent of any possible thought of the reviewers in respect to the validity of the claim made. Not infrequently there apparently has been some question about whether or not effects of light had been clearly separated from possible effects of temperature differences.

In many instances the summary statement used here follows quite closely the wording of statements made in the original paper. The conclusions presented in the original papers are, of course, more extensive in many cases; the statement used here is intended only to indicate the general nature of the experiments as a help to the reader in deciding whether or not he should consult the original reference. The original authors' terminology in respect to fungal morphology and nomenclature is followed here. In some cases information cited here was obtained from the Review of Applied Mycology, books, or other secondary sources and the original papers were not examined by the present writers. In such cases this fact is indicated in the literature citation.

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LITERATURE SUMMARIES

PHYCOMYCETES

Achlya recurva. Cultures were placed in darkness and in diffuse daylight on top of a laboratory table at approximately the same temperature. They were examined after 72 hours. Dark cultures were then left in daylight for an additional 72 hours. Light was necessary for the germination of zygotes. (Ziegler, A. W., 1948).

Albugo occidentalis. Hanging-drop slides of conidia were arranged in a chamber at 12° C so that light from a 3-cell flashlight fell on them, while others were placed in the dark. Results after 48 hours showed that spores germinated equally well in light or darkness. (Raabe, R. D., and G. S. Pound, 1952).

Allomyces arbuscula. Cultures exposed to darkness for 7 days and to diurnal illumination for the same period formed zones under both conditions. (Hatch, W. R., 1936).

Blakeslea trispora. Sporangia formed profusely in bright light, subdued light, and total darkness. The shortest sporangiophores were produced in bright light. During their development the sporangiophores were distinctly phototropic. (Weber, G. F., and F. A. Wolf, 1927).

Blastocladiella emersonii. A normal strain and a carotenoid-bearing mutant grew more rapidly in light than in darkness. Illumination induced an increase in CO_2 fixation and concomitantly a large increase in the labeled succinate and a decrease in the labeled ketoglutarate pools in the organism. Both labeled and unlabeled glucose were consumed more rapidly in the light than in the dark. Cell-free preparations mediated an enzymatic TPN-dependent oxidation of isocitrate which was inhibited by bicarbonate and light. These same preparations mediated an enzymatic oxidation of reduced TPN which was accelerated by ketoglutarate and bicarbonate; simultaneously, ketoglutarate was carboxylated. These reactions were further accelerated by light. The mechanism of the effect of illumination was tentatively interpreted in terms of a light-stimulated cyclic process, the S.K.I. cycle. This involved carboxylation of ketoglutarate, via isocitric dehydrogenase and perhaps citritase, to succinate and oxalate, and the further carboxylation of some of the succinate to yield ketoglutarate once again. (Cantino, E. C., and E. A. Horenstein, 1956).

Blastocladiella emersonii. Submerged, liquid cultures proliferated more rapidly and produced greater yields of plant material in white light than in darkness. Illuminated, growing cultures of orange plants grew more rapidly in bicarbonate media and fixed more CO_2 per unit weight of organism produced, than those incubated in darkness. The quantity of light necessary to induce the effect was not high. The degree of stimulation rose linearly with increasing intensity to about 100 f.c. which yielded maximum results; further increase in intensity up to 300 f.c. neither stimulated nor inhibited. The effective spectrum was in the range of 400-500 mμ. (Cantino, E. C., and E. A. Horenstein, 1957).

Blepharospora cambivora. Zoosporangia actively formed only at night, differentiation and release from the sporangium occurring in the morning. Positive phototropism of the zoospores was easily demonstrated in preparations illuminated unilaterally. (Petri, L., 1925).

Choanephora conjuncta. The influence of light is very marked in this species. When subjected to the ordinary illumination of alternating daylight and darkness, the fungus forms conidia at night which mature during the early hours of daylight. If, however, the fungus is kept in constant darkness, the formation of conidia is totally inhibited. (Couch, J. N., 1925).

Choanephora cucurbitarum. Cultures were illuminated at 60 f.c. with a daylight fluorescent light at 25° C. For total darkness, cultures were put into a cardboard box in a darkened room at the same temperature. Conidia failed to form in continuous bright light or in continuous total darkness. When cultures were exposed to alternate light and dark periods, (approximately 12 hours each), numerous conidial heads were produced. (Barnett, H. L., and V. G. Lilly, 1950).

Choanephora cucurbitarum. Cultures were incubated in a constant temperature room at 25° C in continuous light, in continuous total darkness, and in 12-hour light-dark cycles using white, blue, green, yellow, and red light of known wave length. No conidia were produced in continuous bright light, continuous total darkness, or in red light under the 12-hour light-dark cycle. Conidial heads were formed only in darkness after a minimum of 2 hours' exposure to bright light and in continuous light of low intensity. The following approximate numbers of conidial heads were produced under the different colors of light used in the 12-hour cycle: white (2000), blue (50-100), green (25-50), yellow (0-10). (Barnett, H. L., and V. G. Lilly, 1953).

Choanephora cucurbitarum. The fungus could fruit in complete darkness but equal periods of light and darkness were most stimulative to fruiting. Red light was slightly inhibiting to fruiting. Yellow light promoted a fluffy aerial mycelium, while exposure to blue or violet light led to a much more compact mycelium and red or yellow-red light resulted in an intermediate condition. (Christenberry, G. A., 1938).

Cokeromyces recurvatus. Continuous illumination at high intensities, exposure to alternating day and night illumination, and growth in total darkness were found to favor zygospore production. Only under continuous illumination at low intensity was zygospore production suppressed. The effect of total darkness upon growth and sporulation was slight. Cultures so exposed produced both zygospores and sporangioles. The only noticeable variation in these cultures was that some lacked zonation and others developed distinct rings. The effects of specific wave lengths of the visible spectrum upon growth and sporulation were negligible. Zonation occurred in cultures kept in complete darkness as well as in alternating light and darkness. (Poitras, A. W., 1954).

Conidiobolus paulus. Phototropic conidiophores were produced. (Drechsler, C., 1957).

Conidiobolus physosporus. Conidia were produced much more freely in light than in darkness. Discharged conidia, caught on a 2 percent malt agar plate and left in the light, germinate directly to give secondary conidia which are discharged on to the lid of the dish (when illuminated from above). When, however, the spores caught on the agar are allowed to germinate in the dark, mycelium production is promoted. In cultures grown for a few days in darkness and then transferred to light, it can be seen that the irregular hyphae give off straight branches which grow vertically or nearly so. When these hyphae break through the agar surface they are clearly destined to be conidiophores and are positively phototropic. (Dring, V. J., 1958).

Conidiobolus villosus. Conidiophores are strongly positively phototropic. (Martin, G. W., 1925).

Cystopus candidus (= albugo). No difference was observed in the time or percentage of conidial germination in light as compared with darkness. (Melhus, I. E., 1911).

Dicranophora fulva. It was found that sporangia are formed only when there has been some illumination, whereas the early stages of zygospore formation occur only in the dark. A very slight exposure to light is sufficient to induce sporangial formation, and to inhibit the development of the larger zygophoric branches, which lose their contents into the surrounding mycelium and are left as empty sacs. (Dobbs, C. G., 1938).

Haliphthoros milfordensis. Light had no apparent effect on sporulation. (Vishniac, H. S., 1958).

Karlingia rosea. Cultures were grown in daylight and in complete darkness. Pigmentation was more intense in the light. (Haskins, R. H., and W. H. Weston, Jr., 1950).

Mucor dispersus. Cultures all produced significantly larger spores when grown in the dark than when grown in light of approximately 120 f.c. (The light source was daylight fluorescent lamps.) (Williams, C. N., 1959).

Mucor flavidus. Cultures on Raulin's liquid medium were placed near a north window from which they received daylight through various colored filters (discontinuous light). In white light and violet light mycelium, sporangia, and chlamydospores developed. In blue light myce-

lium but no sporangia developed. In yellow light mycelial development was sparse and neither sporangia nor chlamydospores formed. In red light mycelium developed with droplets of oil but no sporangia or chlamydospores formed. In darkness mycelium appeared and also what looked like sporangia, but no spores developed. (Lendner, A., 1897).

Mucor jansseni. Three different culture series were set up: 1) in the light of the room; 2) in the dark but interrupted with 1 minute of light from the room after 3 days; and 3) in the dark continuously. The continuous-dark cultures showed much branching of the sporangiophores, the interrupted dark cultures less branching, and light cultures even less branching. These observations were made after 8 days. There were no clear cut differences when observations were made after 3 weeks. (Zobl, K. H., 1943).

Mucor mucedo. Cultures on a medium composed of Van Tieghem solution, 2 percent agar, and 2 percent beer wort were placed near a north window from which they received daylight through various colored filters (discontinuous light). In diffuse white light long, normal sporangiophores formed with sporangia on the part of the culture farthest from the center. Filaments in the center were short and thin. In red, yellow, blue, and violet light and darkness development was the same as in diffuse light. Heliotropism was strong all over the culture. (Lendner, A., 1897).

Mucor racemosus. Cultures were grown on Raulin's liquid medium for 8 days near a north window from which they received daylight through various colored filters (discontinuous light). In white and blue light mature sporangia with spores were produced. In blue light some sporangia did not develop spores but were filled with oil. In violet light mature sporangia were uncommon, others were filled with oil. In yellow light sporangia were rare but some spores were produced. In red light normal sporangia were very rare and the remainder were abortive; spores were slow in forming. In the dark sporangial production was sparse and no spores were ever produced. In all the cultures, the fungus produced mycelium with chlamydospores. Blocking the passage of ultra-violet rays had no influence on spore formation. On solid Van Tieghem medium (Van Tieghem solution with 2 percent agar) completely mature sporangia were produced in all cultures under the different light conditions. (Lendner, A., 1897).

Mucor rhamnoides. The fungus was grown for 6 weeks on potato-dextrose agar in darkness and in different qualities of light. All cultures developed mycelium. A response to light was not detected. (Bjornsson, I. P., 1956).

Mucor sp. Positive heliotropic curvatures are made by the sporangiophores. (Buller, A. H. R., 1909, p. 75).

Mucor sp. Zonation does not occur under conditions of total darkness. In red and orange light (daylight through liquid filter) alternating with darkness, and in continuous darkness uniform dense spore formation occurred over the entire surface of the medium. When blue light and ordinary light were alternated with darkness (natural diurnal cycle) distinct daily rings of alternating dense and sparse spore formation occurred. Green light in the same cycle produced less distinct rings of growth. Rings of sparse spore formation were formed during the day and the denser ones at night. Blue light inhibits spore formation. (Hedgecock, G. G., 1906).

Mucor stolonifer. Light may cause and accelerate streaming when alternated with darkness in those fungal filaments that are in a condition for streaming. (Andrews, F. M., 1912).

Mucor stolonifer. Protoplasmic streaming is accelerated by diffuse white light. (Schröter, A., 1905).

Mycotypha microspora. Plate cultures were subjected to artificial light during the night for several weeks. Other plates were kept in constant darkness for the same period of time. Both sets of cultures produced fertile heads. The conidiophores were positively heliotropic. (Fenner, E. A., 1932).

Peronospora parasitica. Unilateral daylight illumination did not produce a phototropic response in the germ tubes of the spores. (Robinson, W. 1914).

Phycomyces blakesleeanus. The phototropically sensitive zone contains carotene, particularly beta-carotene, which the author suggests may act as a light receptor. (Bünning, E., 1937a).

Phycomyces blakesleeanus. The author determined the action spectrum with respect to the phototropic curvature of the fungus. (Bünning, E., 1937b).

Phycomyces blakesleeanus (+ strain). A single-celled, elongating sporangiophore responds to a sufficient increase in intensity of illumination by an increase in growth rate. The reaction time is compound, consisting of an exposure period and a latent period (this comprising both the true latent period resulting from photochemical action and an "action time" necessary for the response). During the latter period the plant may be in darkness, responding nevertheless at the end of the latent period. (Castle, E. S., 1929).

Phycomyces blakesleeanus (+ strain). The reaction time of the direct growth response of the sporangiophore to light consists of a series of at least three major identifiable components: 1) an exposure period during which photochemical change occurs; 2) a latent period involving products directly consequent upon the photochemical action; and 3) an action-time occupying a further interval before the growth acceleration appears. The reaction time of the phototropic response of the sporangiophore following stimulation by unilateral illumination is also compound, and is made up of at least three components comparable to those of the direct growth response. The reaction time of each mode of response is constant for a particular intensity of illumination provided that the duration of the exposure period exceeds a certain value. Below that value the reaction time increases progressively as the exposure time decreases. (Castle, E. S., 1930).

Phycomyces blakesleeanus (+ strain). With sporangiophores of high sensitivity, illuminated from one side by light of 171 f.c., a state of phototropic "indifference" was found over a range of exposures extending from continuous illumination down to a duration of exposure of about 0.6 seconds. When the exposure is further shortened, positive phototropic bending occurs. Sporangiophores which exhibit such "indifference" are nevertheless shown to give a distinct direct growth response as a consequence of the same unilateral illumination. The date of "indifference" is therefore not characterized by the absence of photic excitation, but by the failure of the light to evoke a differential acceleration of growth on the two sides of the sporangiophore. Stimulation of sensitive "indifferent" sporangiophores by flashes of light of progressively reduced duration of exposure leads to the discovery of a critical duration below which "indifference" is abolished and phototropic bending occurs. The critical duration of exposure to light for the appearance of the phototropic response corresponds to the critical duration of exposure for minimum reaction time in the direct growth response. Phototropic bending appears, therefore, when the action of light on one side of the sporangiophore is submaximal. Conversely, "indifference" is due to equal and maximal photochemical action on both sides. (Castle, E. S., 1931a).

Phycomyces blakesleeanus (+ strain). The phototropic effects of different spectral regions were equated by means of cultures of elongating, sensitive sporangiophores placed in beams of light opposed at 180°. The relative intensities of the two beams were then adjusted until equal numbers of sporangiophores bent toward each source of light. At this point of equal phototropic effect, the efficiency of each spectral region was taken as inversely proportional to its relative energy content. Sporangiophores were found to be most sensitive to stimulation by light in the violet region (between 400 and 430 mμ). Toward the red (near 580 mμ) sensitivity falls to nearly zero, while in the near ultra-violet (around 370 mμ), sensitivity is still high. The action of light on the photosensitive meristematic region of the elongating sporangiophore leads to a temporary acceleration of growth. If the sporangiophore receives unequal illumination on opposite sides, phototropic bending typically occurs, directed toward the more intense source of light. (Castle, E. S., 1931b).

Phycomyces blakesleeanus. Using a small arc-lamp, a water screen, and a range of intensities, negative bending was never obtained with actively growing sporangiophores, even after 2 hours' exposure. Using a $CuSO_4$ solution screen, only phototropic "indifference" was found. In no case did negative bending occur. Negative bending was obtained by sufficiently intense and prolonged infra-red radiation but the author attributes this to a heating effect (thermotropism). (Castle, E. S., 1932).

Phycomyces blakesleeanus (+ strain). When sporangiophores were exposed to ultra-violet light of wave length 280 mμ , negative curvatures began to develop after about 5 minutes, and after 20 to 30 minutes most of the sporangiophores had curves through at least 90°, pointing directly away from the light source (unfiltered green light, isolated from a General Electric H85C3 capillary mercury lamp by a Bausch and Lomb grating monochromator with quartz optics). Experiments with rotating cultures illuminated with ultra-violet light (280 mμ) show that growth is temporarily promoted by 50 to 100 percent. The negative curvature can therefore be ascribed to acceleration of growth on the near side. (Curry, G. M., and H. E. Gruen, 1957).

Phycomyces blakesleeanus. When the fungus was cultured on the standard medium in the dark, beta-carotene production was only about one-half of that produced in the light, while the fat and dry weight were not affected. (Garton, G. A., T. W. Goodwin, and W. Lijinsky, 1950).

Phycomyces blakesleeanus. When grown in the dark, the dry weight and lipid production by both plus (+) and minus (-) strains were indistinguishable from those obtained with cultures kept in the light. In both strains beta-carotene production was only one-half of that produced in cultures grown in the light. Cultures were grown in bottles wrapped with red, green, and colorless cellophane, respectively, to study the effect of wave lengths on beta-carotene production. As long as the fungus is exposed to light, it produces normal amounts of beta-carotene, irrespective of the wave length of the light. (Garton, G. A., T. W. Goodwin, and W. Lijinsky, 1951).

Phycomyces nitens. The sporangiophores are short when a culture is fully exposed to light, but attain a length of 20 to 30 cm if the fungus is grown on a layer of medium placed at the bottom of a tall vessel which allows light to enter only from the top. (Smith, G., 1946, pp. 204-207).

Phycomyces sp. A physical basis is demonstrated, in the case of a cylindrical cell illuminated with parallel light from one side, for greater photochemical action in the half of the cell farthest from the source of light, when the cell is surrounded by a medium of refractive index less than that of the cell. Factors governing the balance and magnitude of unequal action of light in the two halves of the cell are: the refractive index of the cell, the cell radius, and the absorption coefficient of the intracellular pigment. A limiting value of absorption coefficient is deduced which cannot be exceeded in cells of a particular size showing positive phototropism. In terms of this mechanism the positive phototropism of Phycomyces in air is explained. (Castle, E. S., 1933).

Phycomyces sp. The magnitude of the temporary growth acceleration produced by a brief flash of light increases with increasing length of the dark period before the flash. (Castle, E. S., 1935).

Phycomyces sp. The effectiveness of polarized light in stimulating growth of the sporangiophores depended on the plane of polarization. However, when sporangiophores were immersed in a medium of refractive index similar to that of protoplasm, this difference in effectiveness disappeared. The author interprets the latter result to indicate that the differences in air are due to simple Fresnel reflection losses and not to dichroism of oriented photoreceptors. (Shropshire, W., Jr., 1959).

Physoderma maydis. Sporangia failed to germinate in darkness. Under continuous illumination from a fluorescent light a measurable increase in germination occurred at 0.1 f.c. and the germination increased in a step-wise manner up to about 50 percent germination at 12 f.c. No further increase occurred with light intensities up to 393 f.c. Blue light was most effective. The mean percentage germination for two experiments was 0 in red or yellow light, 15 in green light, 49 in blue light, and 46 in white light. Three foot-candles of blue light resulted in 61 percent germination, while 72 f.c. of yellow light gave 0 percent germination. (Hebert, T. T., and A. Kelman, 1958).

Physoderma zeae-maydis (= P. maydis). Sporangia did not germinate in total darkness. Eighty-seven percent of sporangia which received light from a north window germinated. Sporangia also germinated in the presence of light from an electric lamp (50-watt Westinghouse daylight bulb). No germination occurred in direct sunlight. (Voorhees, R. K., 1933).

Phytophthora cambivora. For summary see Blepharospora cambivora. (Petri, L., 1925).

Phytophthora cinnamomi. Sporangia were produced in culture in continuous artificial light, in darkness, and in alternating light and dark periods. (Zentmyer, G. A., and L. A. Marshall, 1959).

Phytophthora faberi. When a suspension of sporangia was made in tap water, more sporangia discharged their contents when the suspension was well illuminated than when it was kept in darkness. Swarming occurred in the absence of light. When grown in the dark on maize-meal agar, cultures of all strains tested produced very few sporangia but these were, on the average, larger than those produced in cultures grown on the same medium in light. Light influences the size of chlamydospores in the same way that it affects the dimensions of sporangia. (Gadd, C. G., 1924).

Phytophthora faberi. Spores were produced copiously in all cultures after exposure to ordinary laboratory light for 4 days. If the cultures were kept in a dark chamber or incubator, free from light, only a few spores were formed. There were apparently more chlamydospores than conidia produced in darkness. Growth in light was more granular than that in darkness. (Reinking, O. A., 1923).

Phytophthora fagi. Conidial counts sometimes showed more conidia in the light than in the dark and sometimes just the opposite. Conidia were always quite numerous in cultures grown in the dark at 22° C. Therefore, the author thought it doubtful that light can be considered as one of the essential factors in conidial formation. (Waterhouse, G. M., 1931).

Phytophthora infestans. Cultures were placed in light and in darkness. An attempt was made to maintain the temperature constant by keeping ice with lighted cultures to overcome heat effects. Light, either direct or diffuse, did not influence germination. The cultures germinated equally well in both light and darkness. (Melhus, I. E., 1915).

Phytophthora parasitica. Light seems to influence the formation and emission of zoospores but germination does not seem to be affected by either light or darkness. (Dastur, J. F., 1913).

Phytophthora parasitica var. nicotianae. Air appears necessary for sporangial production, and light does not. (Gooding, G. V., and G. B. Lucas, 1958).

Phytophthora peoniae. Two-day-old cultures, when placed in red and yellow-orange lights for 4 days, ceased conidial and oospore production but when placed in amber, blue, bluish tint (transmitting full spectrum but absorbing infra-red), smoky violet, and canary lights, produced oospores and conidia in abundance. (Cooper, D. C., and C. L. Porter, 1928).

Pilobolus crystallinus. Complete normal development takes place in the absence of light. (Brefeld, O., 1889).

Pilobolus crystallinus. The sporangiophores turned toward the source of light. When the direction of the light source was changed the orientation of the sporangia also changed. (Jaczewski, A. de, 1910).

Pilobolus kleinii. The phototropically sensitive zone contains carotene, particularly beta-carotene, which the author suggests may act as a light receptor. (Bünning, E., 1937a).

Pilobolus kleinii. The author determined the action spectrum with respect to the phototropic curvature of the fungus. (Bünning, E., 1937b).

Pilobolus kleinii. A periodicity in the development of the asexual fruiting body (sporangiophores mature at the end of a dark period and immature at the end of a light period) was established under certain alternating periods of light and darkness of equal and unequal duration. Periodicity was displayed under 12-12 (hours), 16-16, 15-9, and 9-15 cycles. No periodicity was noted under continuous light and in total darkness, and also under 4-4, 8-8, 24-24, 4-20, and 20-4 cycles. (Klein, D. T., 1948).

Pilobolus kleinii. Trophocysts and sporangiophores were formed only after the mycelium had been exposed to light. Wave lengths between 380 and 410 mμ were found to be most effective in inducing the formation of trophocysts. Results of experiments to find which classes of compounds were involved in light absorption suggest that it is a flavin rather than a carotinoid which absorbs light to initiate trophocyst formation. Few sporangia were produced by trophocysts allowed to develop in darkness or continuous light but when cultures were exposed to light twice, the number of sporangia was proportional to the duration of the second exposure. (Page, R. M., 1956).

Pilobolus microsporus. Sporangiophores kept in the dark are greatly elongated and no sporangia are formed on them. (Brefeld, O., 1889).

Pilobolus microsporus. Reproductive periodicity is not inherent but rather is completely conditioned by the diurnal alternation of day and night. The periodicity can be made to disappear by subjecting cultures either to continuous light or continuous darkness. Maturation of sporangiophores, which normally takes place during the morning, can be made to occur at any hour of the day or night, by suitably adjusting the alternating 12-hour periods of light and darkness. (McVickar, D. L., 1942).

Pilobolus oedipus. Complete normal development takes place in the absence of light. (Brefeld, O. 1889).

Pilobolus sp. Sporanges are fired with about the same accuracy toward blue light as toward white light. The reaction to yellow light is much less accurate than that toward either blue or white, while that toward red light is very vague and uncertain. (Allen, R. F., and H. D. M. Jolivette, 1913).

Pilobolus sp. If cultures are placed in parallel in the light and in the dark, the cultures in the light develop spores promptly while those in the dark develop sporangiophores which do not form sporangia at the end. This growth in length continues for 10 to 14 days and sporangiophores attain a length of 8 to 10 inches but then degenerate without forming spores. A period of 2 hours of light is sufficient to make possible the formation of sporangia. In blue light spores formed as in white light, while in yellow light cultures showed continued elongation of sporangiophores as in the dark but without formation of sporangia. In yellow light sporangiophores showed a strong positive heliotropism. (Brefeld, O., 1881).

Pilobolus sp. Phototropic response takes place in every region of the spectrum. The presentation period decreases from red to violet, or conversely, the irritability increases from red to violet. There is no indication of intermediate maxima and minima. (Parr, R., 1918).

Protoachlya hypogyna. The experimental methods employed and the results obtained are similar to those for Achlya recurva. (Ziegler, A. W., 1948).

Rhizophlyctis rosea. For summary see Karlingia rosea. (Haskins, R. H., and W. H. Weston, Jr., 1950).

Rhizopus nigricans. For summary see Mucor stolonifer. (Andrews, F. M., 1912).

Rhizopus nigricans. For summary see Mucor stolonifer. (Schröter, A., 1905).

Rhizopus nigricans. A Petri dish with a culture of the fungus was clamped onto a microscope stage and the end of colony was examined. In diffused light the extension of the radiating hyphae could actually be seen and, after an hour and a half the edge of the colony had advanced almost half the diameter of the field. When the whole apparatus was placed in darkness, the advance was less than half that observed in the light, showing that in this species there was a very definite stimulation of vegetative growth by comparatively weak light. (Smith, G., 1946, pp. 204-207).

Rhizopus sp. Cultures were grown for 12 days in darkness and in continuous or cyclic blue, red, and white fluorescent lights. Cultures in the dark produced very few sporangia and then only at the upper end of the test tube. The rest of the tube was filled with white, intertwined

mycelial strands. White fluorescent light alone or with two blue filters produced the greatest number of sporangia. Cultures in cyclic white or blue light produced fewer sporangia. Sporangial production in continuous red light was inferior to that of the two above-mentioned cycles and the results in cyclic red light were similar to those in darkness. (Bjornsson, I. P., 1956).

Saprolegnia mixta. No noticeable difference was found in growth or zoospore formation between cultures grown in diffuse daylight and those grown in darkness. (Klebs, G., 1899).

Sporodinia grandis. Light and darkness had no effect on spore formation. (Baker, R. E. D., 1931).

Thamnidium elegans. Cultures on Van Tieghem liquid (with 4 percent beer wort) were placed near a north window from which they received daylight through various colored filters (discontinuous light). Sporangia were produced under all light conditions but were more numerous in red and yellow light and darkness than in blue or white light or behind an esculin solution screen (blocks out ultra-violet rays). Cultures in violet light showed intermediate features. Abundant mycelium was produced under all light conditions, and sporangioles were produced in all cultures. The fungus was also cultured on Raulin's liquid medium. In white light mycelium but no sporangia developed. In blue light sporangia and sporangioles were few in number, and sporangiophores were short. In red light and in yellow light many sporangia formed. Few sporangia and sporangioles were produced in violet light. In darkness numerous sporangia (maximum development) formed. (Lendner, A., 1897).

Thraustotheca primoachlya. When cultures were placed at approximately equal temperatures in the dark and in difuse daylight on a laboratory table, it was noted that light was necessary for germination of the zygotes. (Ziegler, A. W., 1948).

ASCOMYCETES

Aleuria repanda. Fruit bodies were heliotropic. Not only do the stalks of the apothecia conform to the incidence of light but also the asci containing the ascospores curved so as to become parallel with the incidence of light. (Elliot, J. S. B., 1927).

Aleuria vesiculosa. Asci are heliotropic -- their free ends are all directed toward the apothecium's mouth. The paraphyses are also positively heliotropic. (Buller, A. H. R., 1934, 6: 286-304).

Anthracobia melaloma. Petri dish cultures, half of which were in the light (wrapped in cellophane) and the other half in the dark (wrapped in heavy black construction paper), were incubated at 24° C for 9 days. The light source was a 40-watt bulb. Mature apothecia were formed in both sets of plates. There were no observable differences between apothecia produced in the light and those produced in the dark. (Rosinski, M. A., 1956).

Ascobolus immersus. The asci are positively heliotropic. (Buller, A. H. R., 1909, 1933, 1: 121, 5: 359-365).

Ascobolus magnificus. Cultures kept in total darkness never formed apothecia. Cultures exposed to light from 5 minutes per day to continuous illumination formed many apothecia. The optimum amount of illumination was found to be about 1 hour per day under the conditions of this experiment. It was found that the blue rays were of primary importance in the formation of apothecia. (Yu, C. C. -C., 1954).

Ascophanus carneus. Cultures were exposed to 95 hours of uninterrupted light of the following qualities: red (630 mμ and up), yellow-green (500-550 mμ), blue-green (490-540 mμ), and blue (430-480 mμ). Cultures were kept in darkness before and after the light period and the temperature was controlled between 16° -17° C. Fruit bodies formed in the four regions in the following numbers (number of fruit bodies in 24 plates): 26, 189, 5731, and 5667, respectively. Blue and blue-green were effective wave lengths. In the red and yellow-green regions the fruiting bodies which were produced were not uniformly distributed over all the plates but were, for some unknown reason, limited to a few of the plates. (Stoll, K., 1936).

Ascophanus carneus. It was found that light is not only necessary for the production of apothecial initials but also for the complete maturation of the apothecia. (Ternetz, C., 1900).

Ascophanus sp. The number of fruiting bodies varied with the spectral region of the incident light as follows: 630 mμ (red end)-26, 500-550 mμ-189, 490-540 mμ-5731, 430-480mμ-5667. (Bünning, E., 1953).

Ascozonus woolhopensis. Light seems to be important for the production of apothecia, for in darkness these are rarely formed. (Page, W. M., 1955).

Botryosphaeria ribis. In culture this organism produces abundant pycnidiospores on many media at temperatures of 25° to 30° C, but only if exposed to sunlight or light from incandescent or fluorescent lamps. (Bragonier, W. H., 1949).

Botryosphaeria ribis. Conidia were never produced in culture in the absence of light and microconidia were rarely produced under any circumstances. (Fulkerson, J. F., 1957).

Botryosphaeria ribis. Cultures maintained under ordinary laboratory conditions of alternate light and darkness became zoned, but zonation did not occur in cultures grown in continuous total darkness. (Wolf, F. T., and F. A. Wolf, 1939).

Botryotinia (Sclerotinia) globosa. Three Petri dishes were placed in the dark in an inoculation room at 18° to 20° C, while three others were placed in the light by a window facing north where the temperature was about 20° C. After 10 days the cultures were examined. The cultures in the dark developed far more sclerotia than those in the light. (Buchwald, N. F., 1953).

Capnodium sp. Zone formation occurred when Petri dishes were exposed to the alternation of day and night at a constant temperature of 33° C, but none formed in darkness under constant temperature. Zonation was due to variation in density of the mycelium. Light is essential for pycnidium formation at low temperatures but pycnidia are formed even in the absence of light at 29° C. Strong light is not essential, for even diffuse daylight has a profound action in inaugurating pycnidium formation. (Sawhney, A., 1927).

Chaetomium spp. Culture plates were kept in the laboratory in diffuse light. The perithecial necks were not well-developed and were not sensitive to light. (Page, W. M., 1939).

Cheilymenia vinaceae. The asci exhibit heliotropic curvature. (Buller, A. H. R., 1934, 6: 285-286).

Ciliaria scutellata. The asci exhibit heliotropic curvature. (Buller, A. H. R., 1934, 6: 285-286).

Claviceps purpurea. Exposure to direct or diffuse sunlight induces pigment formation, which is identical to naturally occurring sclererythrin. (Gjerstad, G., 1956).

Claviceps purpurea. Experiments were carried out both indoors and outside with various colored "Corning" glass filters and a "Vita glass" clear filter. Production of a red color in the medium was found to be due to the shorter rays of the spectrum: the blue, violet, and perhaps "near" ultra-violet. (McCrea, A., 1928).

Claviceps purpurea. Sunlight produces a marked chromogenic effect upon the mycelium of this fungus by causing an intense coloration, carrot red. The stimulating rays for this color effect lie in the blue-violet region of the spectrum. When the fungus was grown in darkness, no aerial mycelium formed nor did any of the characteristic red color appear. (McCrea, A., 1931).

Claviceps purpurea. Natural light either stimulated or inhibited the synthesis, or accumulation, of ergot alkaloids depending on the nature of the growth medium used. (Taber, W. A., and L. C. Vining, 1958).

Coccomyces hiemalis. Cultures were tested in the laboratory. Ascospores and conidia germinated equally well in diffuse light and darkness. (Keitt, G. W., E. C. Blodgett, E. E. Wilson, and R. O. Magie, 1937).

Cochliobolus sativus. Mature perithecia were more numerous in cultures incubated in darkness than in cultures exposed to sunlight. Although perithecia formed under all light conditions, sunlight apparently inhibited to some extent the delimitation of ascospores. (Tinline, R. D., and J. G. Dickson, 1958).

Cochliobolus sativus. An unidentified pink pigment is reported from the mycelium of the fungus. Its production was photo-activated, wave lengths between 390 and 513 mμ being effective. Light in the range of 580-760 mμ was ineffective. (Tinline, R. D., and D. J. Samborski, 1959).

Coniothyrium sp. This fungus, which normally never produced pycnidia until the culture was very old and completely filled the Petri dish, produced numerous pycnidia, some superficial and some buried, after 10 seconds' exposure to a Cooper Hewitt quartz mercury arc. (Stevens, F. L., 1928).

Daldinia concentrica. When placed in continuous darkness, this fungus maintained periodic discharge for 12 days and then ceased to be periodic. When the culture was returned to alternating light (12 hours, 100 f.c.) and darkness (12 hours), periodicity was re-established immediately. In continuous light periodic discharge ceased in 2 or 3 days but was immediately re-established in alternating light (12 hours) and darkness (12 hours). When the fungus was placed under conditions of alternating light and darkness of 6 hours' duration each, two peaks of spore-output were soon developed in the 24-hour period. (Ingold, C. T., and V. J. Cox, 1955).

Dermea sp. Some culture flasks were stored in the laboratory in diffuse light, some kept in a greenhouse shaded from direct sunlight, and some kept in the dark at 15° C. Conidial fruiting bodies were produced under all of these conditions. (Groves, J. W., 1946).

Diaporthe batatatis. Four tubes were set on a laboratory table (diffuse daylight), four more were placed 1 foot from the window (direct daylight), and four others were placed in a tin crate and covered with black paper (darkness). After 48 hours no difference in mycelial growth could be seen. There was, however, a marked difference in the formation of fruiting bodies. Three days after inoculation numerous white specks (inceptive fruit bodies) appeared in the light-exposed cultures but not in those in darkness. The next day the bodies began to darken and pycnospores were found in them. Six days after inoculation a few scattered fruiting bodies were found in the dark cultures. These were much larger than those on light-exposed cultures. Fruiting bodies formed in darkness, though well-developed, were frequently sterile and at no time exuded spores. (Harter, L. L., and E. C. Field, 1913).

Diaporthe onocstoma (ATCC #11324). Cultures treated to daily and single light periods showed no differences from each other and from those grown in the dark. Ridging was produced in all conditions, as were stromatal layers. Perithecia were not produced in darkness nor in any of the light conditions tested. Cultures grown for 1 week in daily light cycles and for 1 week with one 18-hour light treatment showed some discoloration in all light conditions. When cultures were placed in total darkness for an additional week the coloration was greatly intensified. (Wishard, R. H., 1957).

Diaporthe phaseolorum var. batatatis. Cultures in Petri dishes with lids removed were placed 10 inches below a 15-watt General Electric germicidal lamp (2537 Å) and exposed to irradiation for various lengths of time. The results indicated that the same dosage of ultra-violet radiation may favor or inhibit the formation of perithecia depending upon the medium. Cultures were also incubated at 25° C under varying conditions of light. Maximum production of ascospores occurred under alternating light and darkness. Continuous total darkness was unfavorable to the formation of perithecia and pycnidia. Small pycnidia containing almost entirely beta spores were formed on most media and their production on certain media was increased by exposure to ultra-violet irradiation or continuous light. (Timnick, M. B., V. G. Lilly, and H. L. Barnett, 1951a).

Diaporthe phaseolorum var. caulivora. Alternate light and darkness were required for production of perithecial initials, but mature perithecia and viable ascospores developed from perithecial initials in total darkness. (Dunleavy, J., 1958).

Diaporthe sojae. Light is essential to pycnidial development, no pycnidia forming in cultures kept in total darkness during their entire growth period. No longer than 6 hours of exposure to one-half the intensity of bright diffuse light is required to bring about pycnidial production in cultures on favorable media. Artificial illumination is effective in inducing pycnidial production. (Lehman, S. G., 1923).

Dothidella quercina. Pycnidial formation was stimulated either in diffuse daylight or under electric light in comparison with darkness. (Coons, G. H., and E. Levin, 1921).

Elsinoë veneta. The fungus sporulated and grew as well in continuous darkness as in alternate diffuse light and darkness. No morphological differences were observed. Coloration was much paler in continuous darkness than in alternate diffuse light and darkness. (Kemp, W. G., 1953).

Emericellopsis spp. Light made little difference in the color or growth habit of the several species studied. (Durrell, L. W., 1959).

Endothia parasitica. Cultures on nutrient agar were incubated in a constant temperature room at 25° C in constant light, in continuous total darkness, and in 12-hour light-dark cycles using white, blue, green, yellow, and red light of known wave length. In continuous light approximately 10,000 small pycnidia and many conidia were produced while in continuous darkness approximately 50 large pycnidia and many conidia were formed. The following approximate numbers of pycnidia and conidia were produced under the different colors of light in the 12-hour cycle: white (6000 small pycnidia, many conidia), blue (1500 pycnidia and many conidia), green (1200 pycnidia, conidia present), yellow (600 pycnidia, conidia present), and red (200 large pycnidia, conidia present). (Barnett, H. L., and V. G. Lilly, 1953).

Endothia parasitica. Pycnidia formed in both light and darkness. (Leonian, L. H., 1924).

Endothia parasitica. This fungus forms pigment poorly under red or far-red or in the dark. (McClellan, W. D., H. A. Borthwick, I. Bjornsson, and B. H. Marshall, Jr., 1955).

Erysiphe graminis. Conidia sown in a drop of water and exposed to light -- both daylight and a 60-watt electric lamp -- from one side only did not show any phototropism. (Cherewick, W. J., 1944).

Erysiphe spp. Spores were germinated from several hosts in unilateral light, some grew germ tubes toward the source of light (collections from 16 different host plants), whereas others (collection from nine different host plants) showed only random orientation with respect to light source. (Neger, F. W., 1902).

Eurotium herbariorum. In general, experimental results show that light does not check vegetative growth but perithecial development is considerably depressed. (Gupta, D. D., 1951).

Fimetaria fimicola. The beaks of the fruit bodies are positively heliotropic. (Buller, A. H. R., 1933, 5: 103).

Galactinia badia. Asci exhibited positive heliotropism. (Buller, A. H. R., 1934, 6: 304-308).

Gelasinospora calospora var. autosteira. Light was found to be important in that few or no perithecia or protoperithecia were produced in cultures incubated in the dark. Pigmentation and aerial mycelium were more pronounced in cultures grown in the dark. (Tylutki, E. E., 1958).

Gelasinospora tetrasperma. Rudiments of perithecia developed in both light and darkness on bisexual mycelium, but the completion of development was more rapid in the light. (Dowding, E. S., and A. H. R. Buller, 1940).

Glomerella cingulata. Production of perithecia was stimulated by irradiating 4- to 7-day-old cultures with ultra-violet light from a quartz mercury arc. (Stevens, F. L., 1928).

Glomerella cingulata. Acervulus formation is strongly influenced by irradiation. About 50 monosporous cultures were studied. Some produced perithecia readily and others only acervuli. Some bore perithecia whether irradiated or not. Some produced no perithecia, others bore perithecia only when irradiated. Thus, numerous strains were recognized. (Stevens, F. L., 1930b).

Glomerella cingulata. Ultra-violet irradiation stimulated perithecial production. (Stevens, F. L., 1931a).

Guignardia bidwellii. The fungus appears to sporulate equally well in continuous light, darkness, and alternate light and darkness. (Lilly, V. G., M. B. Timnick, and H. L. Barnett, 1949).

Helotium ciliatosporum. When pieces of stem bearing the fungus were suspended in stoppered jars with the lower end dipping into water, apothecial rudiments at first grew straight out from the substratum, showing no reaction to light. When they were about 5 mm long their tips began to curve towards the light. As the cultures aged the tips lost all orientation with reference to light direction. (Barnes, B., 1933).

Helotium scutula. Developing apothecia show marked positive heliotropism, the effect varying with the intensity of the light. The young fruit bodies behave in blue light as in daylight and in orange light as in darkness. If young apothecia are exposed to the simultaneous influence of light and gravity, the former has the stronger influence. The power of response to the influences of light and gravity disappears as soon as the hymenial discs begin to form. Fruit bodies are initiated in darkness but cannot develop without the influence of light. If the early stages began in light, development can continue in darkness. (Grove, J. H., 1930).

Hypomyces solani. Cultures were exposed to darkness and to the natural diurnal light cycle on a laboratory table. No perithecia developed in the dark; light was necessary for their formation. (Hwang, S. W., 1948).

Hypoxylon fuscum. When subjected to a diurnal light cycle in a laboratory, with daylight from a north window and very small variations in temperature, the fungus discharged many more spores at night than during the day. The author indicates that light is a master factor in determining periodicity of spore discharge in some species and inhibits it in others. See also summary for Nectria cinnabarina. (Ingold, C. T., 1933).

Hysterographium fraxini. The fungus formed numerous fruiting body initials in the laboratory in the light, a few in darkness at room temperature, and none in darkness at 21° C. (Zogg, H., 1944).

Lambertella corni-maris. Light appears to be a factor of importance in stimulating the formation of apothecia. Cultures wrapped in transparent cellophane formed mature apothecia. Cultures wrapped in white paper formed numerous long stipes. No fruiting structures were formed on cultures wrapped in black paper. (Harrison, T. H., and A. F. El-Helaly, 1935).

Melanospora destruens. Cultures were exposed to light on a laboratory bench beside other cultures wrapped in black paper. No significant difference occurred in the number of perithecia formed, but those produced in continuous darkness were much smaller. (Asthana, R. P., and L. E. Hawker, 1936).

Melastiza miniata. The asci show positive heliotropic curvature. (Buller, A. H. R., 1934, 6: 285-286).

Mycosphaerella cucumis. Seven-day-old cultures on potato-dextrose agar were irradiated with a Mercury-quartz lamp (Westinghouse Sterilamp) for various periods of time (1/2, 1, 5, 10, 15, 20, 30, and 40 minutes). After the treatment, all plates were kept in complete darkness at 24° C. Non-irradiated plates served as controls. On the fourth day after irradiation sporulation occurred in all the irradiated plates but was most abundant in those irradiated for

15, 20, and 30 minutes. None of the controls showed a trace of fruiting bodies. In another series of experiments on various media, it was shown that the amount of sporulation was increased on those media in which it occurred only sparsely without irradiation. (Chiu, W. F., and J. C. Walker, 1949).

Nectria cinnabarina. When a group of dry perithecia is first wetted the discharge of spores may occur at a high rate both night and day, but later a diurnal periodicity of discharge occurs with many more spores being ejected during the daytime. The effect is interpreted as being due to light. (Ingold, C. T., 1933).

Neurospora crassa. Zonation occurred in cultures grown with a light-dark cycle and also in continuous darkness, but was inhibited by continuous light. (Brandt, W. H., 1953).

Neurospora crassa. The Monilia stage was positively heliotropic. (Faull, A. F., 1930).

Neurospora crassa. Both phytofluene and the carotenoids are formed in the dark but only the production of the colored polyenes is stimulated by illumination during the growth period. Red light has no stimulatory effect on pigment production. The effective wave lengths are contained in a broad spectral region extending from 510-366 mμ. (Haxo, F., 1949).

Neurospora crassa. Light does not seem to influence the rate of growth of Neurospora when the temperature is held constant. Cultures kept in a water bath in a room well lighted during the day and dark at night showed no significant differences in growth rate between day and night. Light stimulates the production of yellow pigment at least in some strains and influences the formation of conidia in certain strains. (Ryan, F. J., G. W. Beadle, and E. L. Tatum, 1943).

Neurospora crassa. Visible light, mainly blue-violet light, applied during the growth of a mutant depressed both melanogenesis and tyrosinase activity in the mycelium. This light effect seems not to be mediated by the action of a tyrosinase inhibitor. Light is therefore believed to induce either a decreased production or an inactivation of the enzyme. (Schaeffer, P., 1953).

Neurospora crassa. The fungus was incubated for 4 days in a dark room, followed by 10 days' illumination with a 14-watt daylight fluorescent lamp at a distance of 50 to 60 cm. Certain cultures kept wrapped in tinfoil appeared almost colorless. Evidence indicated that light fosters the conversion of phytofluene into carotenoid pigments and also accelerates to some extent the formation of phytofluene. (Sheng, T. C., and G. Sheng, 1952).

Neurospora crassa. Submerged cultures, grown on liquid medium containing Tween 80, never produced conidia. These cultures remained colorless and pigmentation started only after exposure to light and oxygen. Illumination as short as 1 minute stimulated production of full color but was effective only in the presence of sufficient oxygen. Further synthesis could occur in the dark, but not under anaerobic conditions. (Zalokar, M., 1954).

Neurospora sitophila. Ascospores were ejected in the direction of a unilateral source of illumination. (Backus, M. P., 1937).

Neurospora sp. Production of carotenoids was proportional to the light dosage. The action spectrum was determined. There was no light action beyond 520 mμ. The action spectrum corresponded best to a spectrum of a riboflavin derivative, and no other pigments with a similar spectrum could be detected in the fungus. It was therefore assumed that a flavin was the photoreceptor. (Zalokar, M., 1955).

Neurospora sp. The mycelium, when grown in darkness, was pale orange in color. Exposure to white light for a day resulted in intensification of pigmentation. Extinction values of the total pigment increased greatly. Cultures illuminated continuously for the total growth period were bright reddish-orange, and their pigment content was about four times greater than that of parallel cultures grown in the dark. The absolute amounts of phytofluene present were practically independent of the illumination, while the biosynthesis of the colored polyenes was markedly stimulated by continuous illumination during the growth period. (Zechmeister, L., and F. Haxo, 1946).

Penicilliopsis clavariaeformis. The fungus was grown in the dark and produced an orange pigment, $C_{30}H_{24}O_8$, m.p. 330° C (decomp.), which was isolated and named "penicilliopsin." (Oxford, A. E., and H. Raistrick, 1940).

Philocopra curvicolla. Culture plates were kept in the laboratory in direct light. The necks of the perithecia were strongly phototropic. Spores were shot off in the dark and in increased numbers in the light. (Page, W. M., 1939).

Philocopra pleiospora. When culture plates were kept in the laboratory in direct light the necks of the perithecia were strongly phototropic. (Page, W. M., 1939).

Philocopra setosa. Plate cultures were kept in the laboratory in diffuse light. The necks of the perithecia were strongly phototropic. Spores were shot off in the dark and in increased numbers in the light. (Page, W. M., 1939).

Physalospora obtusa. Cultures on potato-dextrose agar did not ordinarily produce pycnidia in the absence of light. Cultures irradiated with fluorescent light of different intensities and qualities produced mature pycnidia. Light of 200 f.c. for 12 to 18 hours induced pycnidial production. No pycnidia were produced under transmitted red light, very few under the yellow, and a moderate number under the green or white light. All cultures irradiated under the transmitted blue light produced abundant pycnidia. Ultra-violet radiations had no effect on the process. (Fulkerson, J. F., 1955).

Pleospora herbarum. Variations in illumination had no apparent effect on zonation. (Ellis, M., 1931).

Podospora anserina. When plate cultures were kept in the laboratory in diffuse light, the necks of the perithecia were strongly phototropic. (Page, W. M., 1939).

Podospora curvula. The neck region of the perithecium points toward the incident light. Spores are discharged mainly between 10:00 A.M. and 4:00 P.M. (Ingold, C. T., 1928).

Podospora minuta. Plate cultures were kept in the laboratory in diffuse light. The necks of the perithecia were short but the entire perithecial body sloped toward the source of light. (Page, W. M., 1939).

Pyrenophora bromi. Germination of ascospores and conidia was equally good in light and darkness. (Chamberlin, D. W., and J. L. Allison, 1945).

Pyronema confluens. When exposed to light the fungus is induced to form fruiting bodies. High light intensities for short time periods were not as effective as low light intensities for longer periods. Under limiting light conditions the fruiting bodies developed but did not produce mature spores. (Kerl, I., 1937).

Pyronema confluens (P. omphaloides). Light energy can be utilized in the production of reproductive structures only if a check to vegetative growth has previously occurred. Using light filters of known wave length transmission, it was found that the blue end of the spectrum was responsible for pink pigment production and development of reproductive structures. (Robinson, W., 1926).

Sclerotinia fructicola. The fungus must have alternating light and darkness for the production of zones. When the fungus is grown in darkness sporulation is uniform and intense. (Hall, M. P., 1933).

Sclerotinia fructicola. For summary see Monilia fructicola. (Jerebzoff, S., 1958).

Sclerotinia fructigena. The fungus produced concentric zones of conidia only in cultures maintained under natural alternations of light and darkness. Reduction in hours of light decreased zonation. In darkness mycelial development was copious and only a single zone of conidia occurred in the center. (Bartels, G., 1954-55).

Sclerotinia fructigena. In darkness and in 12-hour alternations the fungus produced an irregular colony, in the latter case showing some zonation. Under all other conditions growth was regular. Growth was slowest in total darkness and faster in continuous light than in the 12-hour alternations. When the period of alternation was shortened the growth increased. (Dickson, H., 1939).

Sclerotinia fructigena. Spores of the fungus germinate as well in sunlight as in darkness provided the conditions of temperature and moisture remain near the optimum. (Doran, W. L., 1922).

Sclerotinia (Monilia) fructigena. The apothecia produced from peach sclerotia were positively phototropic. (Norton, J. B. S., W. N. Ezekiel, and R. A. Jehle, 1923).

Sclerotinia fructigena. In light the fungus develops vigorous aerial mycelium with numerous macroconidia. In the dark conidial formation is almost completely suppressed and the hyphae grow in contact with the agar. Cultures were grown in a 12-hour light-dark cycle with the light filtered through various Schotts filters. At wave lengths of 390-477 mμ strong zonation with conidial formation occurred during the light period. (Sagromsky, H., 1952b).

Sclerotinia laxa. Cultures must have alternating light and darkness for the production of zones. (Hall, M. P., 1933).

Sclerotinia libertiana. Apothecia produced under unequal illumination are strongly positively phototropic. Light is evidently the stimulus which causes the tip of the sprouts which come from the sclerotium to stop growing in length and to expand into the disks bearing the ascospores. (Stevens, F. L., and J. G. Hall, 1911).

Sclerotinia sclerotiorum. Sclerotia were incubated under various temperature and light conditions on sterile 1 percent water-agar slants. Light was not necessary for growth of stipes, but was apparently necessary for the production of apothecia. (Henson, L., and W. D. Valleau, 1940).

Sclerotinia sclerotiorum. Sclerotia were embedded in moist sand placed 1) in amber-colored bottles, 2) in black-painted bottles, and 3) in clear bottles tightly stoppered, and placed in a greenhouse. Mature apothecia developed normally in full light. Only stipes without hymenium developed in the amber and black-painted bottles. (McLean, D. M., 1958).

Sclerotinia sclerotiorum. Light was necessary for the normal development and expansion of apothecial discs but not for the formation of initials. After initials had appeared, mature expanded apothecia were formed by all isolates studied when exposed to either artificial or natural light. (Purdy, L. H., 1956).

Sclerotinia trifoliorum. Sclerotia, when placed in the dark, germinated and produced long slender stipes with no fruiting discs. With 50 lux of light, long stipes were produced with small fruiting discs. At 500 lux the stipes were shorter and discs larger. At 1000 lux, supplemented with a few seconds of direct sunlight, the stipes were still shorter and the discs broader. (Bjorling, K., 1951).

Sclerotinia trifoliorum. Sclerotia were incubated under various temperature and light conditions on sterile 1 percent water-agar slants. Light was not necessary for the production of apothecia. (Henson, L., and W. D. Valleau, 1940).

Sclerotinia trifoliorum. Apothecial initials were formed in the absence or presence of light between 15° and 20° C. Light, either daylight or artificial, is necessary for the maturation of the fundaments. Light from fluorescent, daylight, or white light bulbs, or from a north window is sufficient for apothecial maturation. (Lane, S. A., and T. Sproston, 1955).

Sordaria fimicola. For summary see Fimetaria fimicola. (Buller, A. H. R., 1933, 5: 103).

Sordaria fimicola. A rough action-spectrum curve (in the range of 400-600 mμ) for light-stimulated spore discharge is compared with the absorption-spectrum curve of an ethyl alcohol extract of the fungus. The two curves show some agreement. (Ingold, C. T., 1958).

Sordaria fimicola. When grown in darkness or light the fungus can develop mature perithecia from which spores are discharged. Under alternating dark and light (12 hours-12 hours) each day spore discharge is periodic (low rate during dark period; a gradual rise to a relatively high rate in the light period, followed by a decline before the onset of the next dark period). Transfer from darkness to light always leads to an increase in the rate of discharge and from light to dark to a decrease. Experiments with light of different quality but roughly the same energy value show that the blue rays are mainly effective. From cultures on filter-paper yeast-extract medium an orange pigment with a maximum absorption in the visible spectrum at 470 mμ can be extracted. (Ingold, C. T., and V. J. Dring, 1957).

Sordaria fimicola. Culture plates were kept in the laboratory in diffuse light. The necks of the perithecia were strongly phototropic. Spores were shot off in the dark and the number discharged increased with the light. (Page, W. M., 1939).

Sordaria fimicola. Cultures all produced significantly larger spores when grown in the dark than when grown in light of approximately 120 f.c. (The light source was daylight fluorescent lamps.) (Williams, C. N., 1959).

Sordaria macrospora. Culture plates were kept in the laboratory in diffuse light. The necks of the perithecia were strongly phototropic. (Page, W. M., 1939).

Sporormia bipartis. The experimental methods employed and the results obtained are the same as for Sordaria macrospora. (Page, W. M., 1939).

Sporormia intermedia. The experimental methods employed and the results obtained are the same as for Sordaria macrospora. (Page, W. M., 1939).

Stromatinia gladioli. Cultures were grown for 4 weeks in continuous white, blue, and red fluorescent light or were left 1 week in darkness prior to 3 weeks under these lights. Control cultures were kept in darkness. Some sclerotia were formed under all conditions, but the fewest were formed in darkness. Cultures in continuous white or red fluorescent lights produced a considerable number of sclerotia. Cultures in continuous blue fluorescent light produced fewer sclerotia than those under the two above-mentioned conditions, but if cultures were left in the dark 1 week prior to the 3 weeks in blue light the greatest number of sclerotia were formed. (Bjornsson, I. P., 1956).

Valsa coenobitica. All the necks of the perithecia turned toward the light. (Defago, G., 1944).

Venturia inaequalis. Leaves, some with the ventral surface toward the light and some with the dorsal surface toward the light, were nailed onto a board out-of-doors. Perithecia were always produced on the side exposed to the light. Perithecia on apple leaves kept in the dark had a variety of abnormal shapes; in some cases several necks were formed, and ascospore viability was impaired. The admission of small amounts of light (20 minutes' daily illumination) promoted normal perithecial development, and one weekly exposure of the same duration induced formation of organs differing only in their profuse development of setae. (Holz, W., 1937).

BASIDIOMYCETES
EUBASIDIOMYCETES

Armillaria mellea. Hyphal tip isolates were grown for 2 months on potato-dextrose agar under light of different qualities. No fruiting bodies were detected. Cultures grown in darkness reached a size double that attained in continuous blue, red, and white fluorescent lights. (Bjornsson, I. P., 1956).

Armillaria mellea. Cultures of the fungus grew better in darkness than in light. Growth was good in yellow light, less luxuriant in green light, and poor in red and blue lights. (Raabe, R. D., 1958).

Armillaria mellea. The total length of rhizomorphs and diameters of colonies were greater in plates wrapped in black paper than in unwrapped ones placed beside them on a well lighted window sill. The number of rhizomorphs produced did not differ significantly. Light does not inhibit the formation of rhizomorph initials, but it slows down rhizomorph elongation. (Townsend, B. B., 1954).

Armillaria mucida. All cultures grown in darkness produced pure white carpophores, whereas those grown in light were a dark brown or fuscous gray, turning light with maturity. When young cultures were transferred from light to darkness, or vice versa, the hue changed to that appropriate to the new condition. When cultures were transferred at a later stage no color changes occurred. Fructifications reached maturity equally well in the dark or the light. (Fischer, C. E. C., 1909).

Clitocybe illudens. Cultures were found to fruit in either light or darkness, although the first stages were always initiated in darkness. (Young, V. H., 1914).

Collybia radicata. Light appears to be unnecessary for sporophore production since a number of sporophores appeared in cultures kept in the dark. (Campbell, A. H., 1938).

Collybia velutipes. The fungus was grown in dark and light incubators at 10°, 15°, 20°, and 25° C, illumination being provided by a mercury vapor lamp and an incandescent lamp. Light was necessary for complete development of fruiting bodies, and only mycelium or fruit body rudiments with stipes but without pilei were produced in the dark. (Aschan, K., 1954).

Collybia velutipes. Cultures on a synthetic medium in continuous darkness produced highly clustered and delicate fructifications with minute pilei, these results suggesting that primordium and stipe production are independent of light. However, when these cultures were transferred to light during the developmental period pileus growth was promoted. (Plunkett, B. E., 1953).

Collybia velutipes. Light was required for normal cap devlopment. (Plunkett, B. E., 1958).

Coprinus comatus. Complete normal development takes place in the absence of light. (Brefeld, O., 1889).

Coprinus comatus (ATCC #12640). Fruiting bodies were not produced in the darkness or under any light conditions tested. Ridging was noticeable under all light conditions and in darkness. It was most prominent at low intensities and in darkness. Coloration of the medium was greatest at low light intensities. (Wishard, R. H., 1957).

Coprinus ephemerus. In darkness the whole fruiting body is weak, lacking in turgor, and small, but when the fungus is placed in light the stipe becomes erect and the pileus develops normally. (Brefeld, O., 1877, pp. 109-116).

Coprinus lagopus. Blue light (400-500 mμ) is required for fruit body formation. Light of over 640 mμ is ineffective. Mechanical stimulation can substitute for blue light and make possible the development of the fruit body. (Borriss, H., 1934).

Coprinus lagopus. The fungus is not greatly affected by light. Although the stipe will elongate in the dark, light is required for pileus formation. The stipes are positively heliotropic. (Brefeld, O., 1877, pp. 98-108).

Coprinus lagopus. Complete normal development takes place in the absence of light. (Brefeld, O., 1889).

Coprinus lagopus. The fungus in an early stage of development was illuminated 10 times every half hour for a period of 2 1/2 days at different wave lengths. The intensity of illumination corresponded about to a white light of 65 lux. The author concluded that the response of Coprinus as measured by degree of stretching of the stalk of the fruit body corresponds more closely to the absorption spectrum of a lactoflavin than to that of a carotinoid. (Bünning, E., I. Dorn, G. Schneiderhöhn, and I. Thorning., 1953).

Coprinus lagopus. Fruiting, which did not commence in darkness until about the 15th day, was accelerated by continuous light or by brief exposures to light between the 7th and the 13th day of incubation. The response was restricted to the area of mycelium actually exposed. In continuous light fruiting generally began in 10 days. Exposures to white light as brief as 1 second at 25 f.c. or 5 seconds at 0.1 f.c. were effective. Only the blue range of the visible spectrum stimulated fruiting, the longest effective wave length being near 5200 Å. (Madelin, M. F., 1956).

Coprinus lagopus. An action spectrum was determined for effect of light in preventing elongation of the stipes of the fungus. The curve had a maximum between 440 and 460 mμ. The upper limit of effective wave length was about 530 mμ. (Schneiderhöhn, G., 1954).

Coprinus lagopus. Light is required for each step in the normal development of fruiting bodies. With continuous illumination a very low intensity is sufficient. If etiolated fruit bodies are placed in light of 2500-5000 lux for 1 hour, and then returned to darkness, a thickening in the stipe is noted in the region which develops shortly after the lighting period. (Vorderberg, K., 1950).

Coprinus myceliocephalus. The fungus required light for normal fruiting. In the dark long stipes developed with small brownish caps. The veil became very much reduced and the caps never opened, but collapsed after a while without ripening spores. Some cultures developed no buds at all in the dark. (Lange, M., 1948).

Coprinus nycthemerus. Fruiting body initials formed in light but not in darkness. (Brefeld, O., 1889).

Coprinus plicatilis. Fruiting body initials formed in blue light but not in yellow. When etiolated stipes were placed in white light, they formed secondary fruit initials all up and down the elongated stipes. (Brefeld, O., 1889).

Coprinus plicatiloides. Positive heliotropic curvature of the stipe causes the pilei to be brought out of crevices in the substratum into the open. (Buller, A. H. R., 1909, 1: 75).

Coprinus sp. Stipe elongation was inhibited by intermittent illumination more than by continuous light of the same quality. The optimum interval between illumination periods was about 15 minutes. Joint effects of successive shaking and illumination treatments are accentuated if they are separated by 30 minutes. (Bünning, E., M. Gröner, and S. Stiefel, 1950 (1951)).

Coprinus stercorarius. Sclerotial formation takes place in either light or darkness, but fruiting body initials form on the sclerotia very seldom in the dark and abundantly in bright daylight. Once the fruiting body initials have been formed, the stipe develops in dark or in light; the stipe is able to develop to a great length (as much as 4 feet) in the dark. Little or no pileus development occurs in the dark. In light the stipe is much shorter and the pileus develops normally. (Brefeld, O., 1877, pp. 13-97).

Corticium praticola. Test-tube cultures were placed in a dark box in an incubator at 24° C and similar tubes just inside the inner glass door of the incubator with the outer door left open to admit light. A 500-watt electric light was placed near the glass door so that daylight could be supplemented by electric light on cloudy days. Basidiospores were more abundant in the light cultures but sclerotia formed only in the cultures which were kept in the dark. (Kotila, J. E., 1929).

Cortinellus berkeleyanus. Sporophores were equally abundant in light and darkness under favorable temperature and moisture conditions. (Nishikado, Y., and Y. Miyawaki, 1943).

Dacrymyces ellisii. Single-point inoculations were made on plates of malt agar, which were then placed in darkness for 15 days. At the end of this period the colonies were whitish to pale buff. After 15 days they were exposed to light of varying intensity for 10 minutes to 10 days and then placed in the dark again. Controls were grown both in complete darkness and in continuous light for the entire experiment. Pigment did not form in darkness, but in light followed by darkness a colorless band formed indicating the amount of growth during darkness.

Once the pigment was formed the colonies did not lose their color on being replaced in darkness. (Bulat, T. J., 1954).

Dacrymyces ellisii. Cultures grown for 30 days in the light at room temperature were removed from the agar, homogenized, and extracted with acetone. The extract was evaporated and the pigments taken up in petroleum ether, saponified, and chromatographed. Ten pigments, of which the major one was beta-carotene, were isolated. A table of carotenoids extracted and related data are presented. (Hanna, C., and T. J. Bulat, 1953).

Fomes annosus. Conidia were formed from 0° to 22.5° C in light or darkness. (Rishbeth, J., 1951).

Fomes fomentarius. Cultures grown in light are darker than those grown in darkness. (Cartwright, K. St. G., and W. P. K. Findlay, 1950, pp. 102-104).

Fomes fomentarius. Diffuse light reduced the amount of growth in comparison with that observed in darkness and made the mycelial mat darker in color. (Fritz, C. W., 1923).

Fomes igniarius. Sunlight caused a decided limitation in growth and a deepening in color of the mycelial mat as compared with the growth and color in darkness or in diffuse light. (Fritz, C. W., 1923).

Fomes rimosus. Cultures grown on suitable media with exposure to sunlight produced sporophores while those grown in the dark did not. (Long, W. H., and R. M. Harsch, 1918).

Fomes roseus. The experimental methods employed and the results obtained are similar to those for Fomes rimosus. (Long, W. H., and R. M. Harsch, 1918).

Fomes texanus. The experimental methods employed and the results obtained are similar to those for Fomes rimosus. (Long, W. H., and R. M. Harsch, 1918).

Hydnum auriscalpium. Both continuous illumination and continuous darkness proved inhibitory to the development of new sporophores and proliferations, and the growing region showed only a weak positive phototropic reaction to unilateral illumination. (Harvey, R., 1958).

Hypochnus (Corticium) sasakii. Sclerotia formed more abundantly in light than in darkness. (Hemmi, T., and S. Endo, 1931).

Lentinus lepideus. The pilei were not produced without a morphogenic stimulus given by light. When a fruiting body is grown entirely in the dark it develops into a horn-like process with no pileus or hymenium. (Buller, A. H. R., 1909, 1: 20).

Lentinus lepideus. Normal fructifications do not form in the absence of light. Instead, coralloid deformations typically occur. (Jaczewski, A. de, 1910).

Lentinus lepideus. The stipe of this wood-destroying fungus grows towards the light and the cap develops only when the intensity of the light exceeds a certain minimum. (Smith, G., 1946, pp. 204-207).

Letinus lepideus. Spores germinated with a unilateral source of illumination did not show any phototropic response. (Snell, W. H., 1922).

Lentinus tuber-regium. The fungus was grown on various agar media and different soil and organic materials at 24° C. The early stages of the fruiting body formed in darkness but the pileus formed only in light. (Galleymore, H. B., 1949).

Lenzites sapiaria. Germ tubes of spores germinated with a unilateral source of diffuse daylight illumination showed no phototropic response. (Snell, W. H., 1922).

Lenzites trabea. Cultures were left in the dark 3 to 6 weeks and exposed for 10 minutes, 60 minutes, 24 hours, and 7 or 14 days to white fluorescent light alone, with two blue or red

filters, and to incandescent filament light with or without two red and two blue filters. Cultures were left for 4 or 8 weeks in the dark after treatments. Basidiocarps formed only in cultures receiving 2 weeks of white fluorescent light alone or with two blue filters or light from incandescent filament lamps. (Bjornsson, I. P., 1956).

Merulius lacrymans domesticus. The fungus was grown in complete darkness and in daylight. Whenever pigment formation occurred in light it also occurred in darkness. The nature of the growth medium had a considerable effect on production of color. Artificial white light, as well as red, yellow, green and blue lights, was used but without effects on color formation. Cultures in the dark showed a much greater tendency to produce mycelium that grew up the sides of the flask to the plug. (Zoberst, W., 1952).

Panaeolus campanulatus. When it is beginning to elongate, the stipe is ageotropic but positively heliotropic, pushing the pileus towards the open or light. After the pileus reaches the open the apical portion of the stipe becomes strongly negatively geotropic and ceases to respond to the stimulus of light. (Buller, A. H. R., 1922).

Panus sp. The experimental methods employed and the results obtained are similar to those for Fomes rimosus. (Long, W. H., and R. M. Harsch, 1918).

Panus stypticus. Darkness appears to favor mycelial growth but not sporophore formation. Intensity of coloring appears dependent on light, for sporophores grown in diffuse light (temperature and humidity constant) are uniformly pale buff, but in bright light they are cinnamon or tan. (Johnson, M. E. M., 1920).

Pellicularia filamentosa. Cultures were placed in a white-walled room with two large windows and exposed to strong diffuse natural light during the day and normal darkness at night. Sporulation under natural light is a periodic function, with heaviest rate in daytime. (Carpenter, J. B., 1949).

Pellicularia filamentosa. For summary see Rhizoctonia solani.
(Durbin, R. D., 1959).

Pleurotus ostreatus. When grown in the dark on bread, the mycelium is at first white; after 3 weeks the center becomes flesh ochre. On the same medium in the light drops of yellowish red liquid are exuded. (Cartwright, K. St. G., and W. P. K. Findlay, 1950, pp. 114-116).

Pleurotus ostreatus. Light is necessary for the formation of fruiting bodies, and for their completely normal development it must be strong (14 hours' daily light of 4000-8000 lux). (Koch, W., 1958).

Pleurotus ostreatus. The experimental methods employed and the results obtained are similar to those for Fomes rimosus. (Long, W. H., and R. M. Harsch, 1918).

Pleurotus sp. Luminosity was independent of previous illumination of the fungus. (Bose, S. R., 1935).

Polyporus agariceus. The fungus can fructify in complete darkness but the rate of elongation and the length of the stipe are increased, and the size of the pileus is slightly reduced. Cultures were induced to fructify in 1 week at room temperature in diffuse light. The stalk of the sporophore was negatively geotropic during its growth but became positively phototropic after the formation of the flattened knob. (Chakrabarty, M., 1941).

Polyporus (Fomes) annosus. The fungus did not fruit in either light or darkness. (Koch, W., 1958).

Polyporus arcularius. Six cultures exposed to normal daylight were compared with six kept in darkness except for periods of daily observations. Over a period of 28 days the daylight-exposed ones gave rise to 51 sporophore initials, of which seven completed development, while those in darkness did not fruit but produced reddish-brown stromatic mycelium in the older parts. Later these dark-grown cultures were exposed to normal daylight and they developed

fertile sporophores. The effects of different periods of illumination and colored light on sporophore formation were also studied. Blue light and green light were effective; orange light was not. Recordings of sporophore formation made after 18 days showed an increase approximately in proportion to the time the cultures were exposed to light. (Gibson, I. A. S., and J. Trapnell, 1957).

Polyporus brumalis. Reductions of transpirational water loss over the approximate range of 6.5 to 0.0015 mg/cm^2/hour at normal atmospheric levels of O_2 and CO_2 were associated with 1) delay of pileus production, 2) increased mean lengths of stipes at pileus initiation, 3) diminished numbers of pileate fructifications, 4) increased final lengths of pileate and epileate fruit bodies, and 5) diminished cap diameter. A very similar but less marked effect was obtained by reduction of light intensity from 160 to 40 f.c. at each transpiration level studied. The effects were additive so that with least light and lowest transpiration pileus suppression was complete in all fructifications. Total darkness prevented cap development even in dry moving air. Fewer fruit bodies were initiated when transpiration rate was low and when light intensity was zero or at low values. Low light intensity also delayed fruiting. (Plunkett, B. E., 1956).

Polyporus brumalis. Light was required for normal cap development. Larger average cap diameters resulted as light intensities were increased over a certain range. In low light the stalks were considerably longer than usual. (Plunkett, B. E., 1958).

Polyporus cinnabarinus. Isolates from various hosts were grown on different media in light and darkness. Most isolates failed to produce sporophores in darkness, while several did produce them on suitable media in light. Several other Polyporus species produced generally similar results. (Long, W. H., and R. M. Harsch, 1918).

Polyporus pargamenus. Darkness is conducive to the most vigorous vegetative growth but retards sporophore formation. The dimidiate form of the sporophore is not to be ascribed solely to the stimulus afforded by light or to that by gravity, but to the combined action of both. The formation of pores and the production of spores, however, depend entirely on light. The presence or absence of light made no perceptible difference in the time required for spore germination. (Rhoads, A. S., 1918).

Polyporus (Daedalea) quercinus. The mycelial mat was at first white with a wide colorless margin and hyphae growing close on the surface of the medium. Growth was similar in light and in darkness, but was slower and denser in light and the colorless margin tended to disappear. A mature culture (1 month old) in light was colored Natal brown and became overgrown with a creamy white woolly mycelium. (Cartwright, K. St. G., 1951).

Polyporus radiatus. On malt agar in the light the fungus exhibits very little aerial development at first, but in the dark a loose cobwebby mycelium soon develops. The culture shows various yellow-brown tints, which are more pronounced in darkness. (Cartwright, K. St. G., and W. P. K. Findlay, 1950, pp. 124-126).

Polyporus schweinitzii. Isolates from a large number of sources were grown on nutrient agar in Petri dishes at a constant temperature (22° C) and exposed to electric light (but never to daylight) for a few seconds every 12 hours. Another series was cultured at room temperature (10° to 25° C) and exposed to diffuse daylight for a few seconds every 4 or 5 days. The fungus was sensitive to light and grew more slowly and displayed darker and more varied coloration when exposed, for even very short periods, to indirect daylight than when kept in darkness. On various substrata, neither sporophore production nor pore formation appeared to depend on exposure to daylight. (Childs, T. W., 1937).

Polyporus schweinitzii. Cultures were grown in tubes in darkness, diffuse light, and where they received about 3 hours' direct sunlight per day. Diffuse light permitted the development of a brilliantly colored mat. In light regular firm-walled hyphae group themselves in strands to form tufts which, growing massed together and perpendicular to the surface, produced a velvety appearance. They were deeply pigmented and without spores. In darkness the aerial mat presented a loose tangle of irregularly, much-branched threads. They were hyaline or slightly yellow in mass and contained chlamydospores. (Fritz, C. W., 1923).

Polyporus squamosus. The pilei cannot be produced without light. When a fruiting body is grown entirely in darkness, it develops into a horn-like process with no pileus or hymenium. If the fruit body is placed in darkness after development of the pileus has been initiated by the light stimulus, further development is normal. The liberation of spores is independent of light. (Buller, A. H. R., 1909, 1: 120).

Polystictus (Polyporus) versicolor. Two small birch branches with fruiting bodies of the fungus were brought into the laboratory and placed into similar moist chambers, one in darkness and the other in light. In darkness a large number of imperfectly formed fruiting bodies developed, none with a true bracket form or pores. In light small normal bracket-like sporophores appeared. When the branch in the dark was transferred to the light typical fruiting bodies formed. Germination of spores was not influenced by presence or absence of light. (Bayliss, J. S., 1908).

Polystictus (Polyporus) versicolor. The fungus requires at least 8 hours of light (1000 lux) per day to produce normal fruiting bodies. Abnormal fruiting bodies are produced in darkness. (Koch, W., 1958).

Poria ambigua. The fungus does not form hymenium and basidiospores in culture unless exposed to light. The blue end of the visible spectrum is effective, the red end is not. Short exposures to faint light are adequate. The effect of light extends into the mycelium, which grows in darkness after illumination. This suggests the production of a substance in light which moves into the mycelium formed later in darkness and induces reproduction. (Robbins, W. J., and A. Hervey, 1959).

Poria sp. The experimental methods employed and the results obtained are similar to those for Fomes rimosus. (Long, W. H., and R. M. Harsch, 1918).

Poria xantha. When grown in darkness a mature culture shows an ill-defined spongy fructification with fine pores at the top of the slope, and below a mat of loose, branching strands appressed to the medium. In light practically the whole surface of the compact, rather chalky mat becomes covered with very fine pores and short tubes growing down from small protuberances. (Cartwright, K. St. G., and W. P. K. Findlay, 1950, pp. 201-202).

Ptychogaster cubensis. Color depended upon intensity of light and in weak illumination some isolations remained white or became only slightly "cream color" around the inoculum in 14 days. Test-tube cultures which were white at first became brown in diffused light. Cultures in darkness remained white. (Davidson, R. W., W. A. Campbell, and G. F. Weber, 1942).

Schizophyllum commune. Cultures were incubated in a constant-temperature room at 25° C in continuous light, in continuous total darkness, in a 12-hour white light-dark cycle, and in a 12-hour colored light-dark cycle. Wratten filters of known wave length transmission were used. No fruit bodies were formed in the absence of light. Several fruiting bodies were formed in continuous white light and in the 12-hour light-dark cycle and the 12-hour blue light-dark cycle. A few atypical fruit bodies formed in green light, a few small ones in the yellow light, and a few abortive ones in the red light of the 12-hour cycle. (Barnett, H. L., and V. G. Lilly, 1953).

Schizophyllum commune. Experiments were performed to test whether light 1) is necessary for fruiting, 2) is required for normal fruit morphology, and 3) by proper manipulation of duration and intensity, can enhance fruiting in genetically determined poor fruiting combinations. The authors state "It appears that light is not required for fruiting but it is required for normal fruiting, although the intensity and duration of light do not appear to be critical. It appears unlikely that the condition of illumination could induce fruiting in a genetically determined poor fruiting combination." (Raper, J., and G. S. Krongelb, 1958).

Sphaerobolus spp. Cultures kept in darkness or very diffuse light produced no basidiocarps. When cultures were placed several feet from a window, all basidiocarps formed pointed directly toward the source of light. The heliotropic response is limited to very young basidiocarps; the direction of light falling upon the maturing fruit body does not affect the direction of the discharge. (Walker, L. B., 1927).

Sphaerobolus stellatus. In the dark the fungus forms mycelium but no fruiting body initials. The latter form only in the light. Their further development into fruiting bodies takes place in either light or darkness, but is faster in light. (Brefeld, O., 1889).

Stereum umbrinum. The experimental methods employed and the results obtained are similar to those for Fomes rimosus. (Long, W. H., and R. M. Harsch, 1918).

Stereum versiforme. The experimental methods employed and the results obtained are similar to those for Fomes rimosus. (Long, W. H., and R. M. Harsch, 1918).

Trametes serialis. Cultures on suitable media and exposed to sunlight produced sporophores, while those in the dark generally failed to do so. (Long, W. H., and R. M. Harsch, 1918).

Typhula gramineum. The production of the fruit body from the sclerotium was studied under several different light conditions: diffuse light, no cover (wave length shorter than 3420 Å), same with violet glass cover (wave length 3420-5050 Å), same with red glass cover (wave length 5400-6000 Å), and darkness. The normal fruit body developed only under diffuse light or light which passed through the vita-glass cover, giving rise to true hymenia and basidiospores. (Tasugi, H., 1935).

Typhula sp. To determine the character of light waves which stimulated fructification, a series of filters were used in an out-of-doors experiment. Glass filters of various wave length transmission were placed over wet cheesecloth-covered boxes containing sclerotia on moist sand. Where ordinary glass (not transmitting waves shorter than approximately 3250 Å) was used, no sporphores were produced. Under a Vitaglass filter (2650-6690 Å) normal fruiting took place. Fertile sporophores were produced under Corning glass filter No. 970 Corex (transmitting 60 percent in region of 3020 Å with a sharp decrease to 10 percent at 2700 Å). Therefore the region which apparently stimulates normal fructification is approximately between 2700 and 3250 Å. Fructification also occurred when artificial illumination from an ultra-violet source was used. (Remsburg, R. E., 1940).

RUSTS AND SMUTS

Cronartium ribicola. Telia were exposed to constant darkness and to constant white light (770 f. c., fluorescent white-light bulbs). Sporidium production occurred under both conditions. (Bega, R. V., 1959).

Melampsora lini. Aeciospores and urediniospores germinated equally well in both light and darkness. (Hart, H., 1926).

Neovossia horrida. Studies on the light requirements for germination of over-wintered chlamydospores showed that 46 hours under a fluorescent lamp of 50 f. c. or 2 hours in direct sunshine was sufficient to promote subsequent germination in darkness. The light reaction was not influenced by temperature, and illumination of dry spores was not effective. (Lin, C. -K., 1955).

Phragmidium mucronatum. When spores were illuminated laterally with light of low intensity no phototropic response was observed. (Cochrane, V. W., 1945).

Phragmidium subcorticium. The germ tubes of uredospores germinated on gelatine agar and exposed to a unilateral source of illumination (lamplight of approximately 200 lux) showed negative phototropism. (Gettkandt, G., 1954).

Puccinia antirrhini. The germ tubes of uredospores germinated on gelatine agar and exposed to a unilateral source of illumination showed no phototropic response. (Gettkandt, G., 1954).

Puccinia coronata. Uredospore germ tubes exhibited negative phototropism to white and blue light. They made no phototropic respnse to green or red light. Blue rays, and to a lesser extent violet, are responsible for the negatively phototropic response of the sporelings to white light. (Forbes, I. L., 1939).

Puccinia coronata. The experimental methods employed and the results obtained are similar to those described for Phragmidium subcorticium. (Gettkandt, G., 1954).

Puccinia coronifera. Uredospores germinated equally well in light or darkness. Germ tubes were negatively phototropic. (Stock, F., 1931).

Puccinia dispersa. The experimental methods employed and the results obtained are similar to those described for Phragmidium subcorticium. Also, working with P. triticina and P. dispersa, Gettkandt determined the action of different wave lengths. She used glass filters 2 mm thick and obtained the following results:

Filter Designation	Wave Lengths	Orientation of Germ Tubes
RG_2	Over 600 mμ	Random
OG_2	Over 550 mμ	Random
GG_{14}	480-over 500 mμ (mostly over 500 mμ)	Random
VG_9	450-560 mμ (max. at 520)	Weakly negatively phototropic
BG_{12}	325-520 mμ	Strongly negatively phototropic
UG_1	290-400 and 700-1100 mμ	Negatively phototropic

(Gettkandt, G., 1954).

Puccinia dispersa. Uredospores germinated equally well in light and darkness. Germination decreased slightly in blue light. Germ tubes were negatively phototropic. (Stock, F., 1931).

Puccinia emiliae. Teleutospores germinated more readily and produced many more sporidia in alternate light and darkness than in continuous darkness. (Maneval, W. E., 1927).

Puccinia glumarum. The experimental methods employed and the results obtained are similar to those described for Puccinia antirrhini. (Gettkandt, G., 1954).

Puccinia graminis. Germ tubes were negatively phototropic. (Stock, F., 1931).

Puccinia graminis avenae. The experimental methods employed and the results obtained are similar to those for Puccinia coronata. (Forbes, I. L., 1939).

Puccinia graminis tritici. Uredospores of Puccinia graminis var. tritici form specialized structures during the infection process. Germinated spores were induced to form these on artificial substrates by proper adjustment of environmental conditions. Under optimal conditions of sunlight at 2000 to 5000 f.c., temperatures of 80° to 85° F and a saturated atmosphere, appressorium-like structures formed in 2 to 3 hours, penetration pegs in 3 to 4 hours, and vesicles in 4 to 6 hours. When this period was followed by 16 to 18 hours of darkness at 85° ± 2.5° F in a saturated atmosphere, formation of vesicles was completed and infection hyphae developed. Conditions above 9000 f.c. and 88° F inhibited the formation of the infection-type structures. If any one factor deviates sufficiently, development and/or differentiation or both stop and do not resume if the factors are brought back in balance. (Emge, R. G., 1958).

Puccinia graminis tritici. Uredospore germ tubes exhibited negative phototropism to white and blue light. No phototropic response to green, violet, and red light occurred. (Forbes, I. L., 1939).

Puccinia graminis tritici. Uredospores exhibited good germination in darkness and with 300 f.c. of daylight illumination. At intensities above 300 f.c. germination decreased. No germination occurred at 1000 f.c. (Sharp, E. L., C. G. Schmitt, J. M. Staley, and C. H. Kingsolver, 1958).

Puccinia helianthi. The experimental methods employed and the results obtained are similar to those for Puccinia emiliae. (Maneval, W. E., 1927).

Puccinia magnusiana. The germ tubes of aeciospores germinated with unilateral daylight illumination showed no phototropic response. (Gettkandt, G., 1954).

Puccinia malvacearum. Sporidia were placed in darkness and with illumination laterally from a window. After 16 hours germination was equally good in light and darkness. Germ tubes of those spores illuminated laterally grew away from the source of the light. (Robinson, W., 1914).

Puccinia menthae. The experimental methods employed and the results obtained are similar to those described for Phragmidium subcorticium. (Gettkandt, G., 1954).

Puccinia poarum. The germ tubes from aecidiospores germinated with exposure to a unilateral source of illumination (lamp-light) showed a slight tendency toward phototropic behavior. (Gettkandt, G., 1954).

Puccinia poarum. Aeciospores were placed in darkness and with illumination laterally from a window. After 16 hours germination was equally good in both light and darkness. Germ tubes in light and dark were indifferent in direction of growth. (Robinson, W., 1914).

Puccinia rhamni. Uredospores were exposed to unilateral illumination from a window. Germ tubes grew away from the source of light. (Fromme, F. D., 1915).

Puccinia simplex. The experimental methods employed and the results obtained are similar to those described for Phragmidium subcorticium. (Gettkandt, G., 1954).

Puccinia suaveolens. The experimental methods employed and the results obtained are similar to those described for Puccinia antirrhini. (Gettkandt, G., 1954).

Puccinia triticina. Uredospore germ tubes exhibited negative phototropism in white light and mostly the same in blue light, but no clear-cut response occurred in red, violet, or green light. (Forbes, I. L., 1939).

Puccinia triticina. The germ tubes of uredospores germinated on gelatine agar and exposed to a unilateral source of illumination showed strong negative phototropism, that is, they grew away from the source of light (daylight). For additional experimental data on this fungus see the summary for Puccinia dispersa. (Gettkandt, G., 1954).

Puccinia triticina. The experimental methods employed and the results obtained are similar to those for Puccinia coronifera. (Stock, F., 1931).

Puccinia xanthii. The experimental methods employed and the results obtained are similar to those for Puccinia emiliae. (Maneval, W. E., 1927).

Tilletia brevifaciens. In preliminary tests about 60 percent of the spores germinated within 8 weeks under light and at cool temperatures; optimum germination occurred at approximately 5° C under constant light. Germination seldom occurred in darkness. (Baylis, R. J., 195

Tilletia brevifaciens. Exposure to diffuse daylight hastened the beginning of spore germination and increased the maximum percentage of spores which germinated. The highest percentage germination attained was 4.5. (Böning, K., F. Wagner, and A. v. Minckwitz., 1953).

Tilletia contraversa. Only an occasional chlamydospore germinated in the absence of light. Continuous exposure to fluorescent light of 150 to 200 f.c. at 5° C resulted in good germination. (Baylis, R. J., 1958).

Tilletia horrida. Chlamydospores were germinated on water agar under light of different qualities. Earliest and best germination took place under blue and white light. Microscopic examination revealed that the growth of germ tubes and mycelium differed under white light and in darkness. (Kreitlow, K. W., 1938).

Tilletia secalis. Chlamydospores germinated profusely in light and darkness on sterilized soil emulsion. (Niemann, E., 1954).

Tilletia sp. Light stimulates spore germination. Apparently the spores (at least some species) germinate only at low temperatures, but also require some illumination. In no case, however, did the percentage germination exceed 4. The maximum light intensity used (1500 lux) gave 2.5 percent germination of dwarf smut spores after 50 days. (Gassner, G., and E. Niemann, 1954).

Uromyces pisi. The experimental methods employed and the results obtained are similar to those described for Puccinia magnusiana. (Gettkandt, G., 1954).

FUNGI IMPERFECTI

Acrothecium lunatum. When exposed to alternations of light and darkness the fungus produced two zones of growth every 24 hours, a pink circle during the day and a white one at night. No zonation was produced in continuous darkness. (Nigam, B. S., 1936).

Alternaria brassicae var. dauci. Evidence is presented to show that conidial formation can be divided into two physiological phases. Light is necessary for formation of sterigmata; conidia are formed in the dark. In constant fluorescent light the hyphae were clearly septate, thick-walled, and with many sterigmata but no conidia. In constant darkness, hyphae were thin-walled and a few conidia formed in the area of the inoculum. When constant-light cultures were subsequently placed in the dark, 50 to 60 percent of the sterigmata formed conidia. With light-dark cycles, rings due to mycelial color and number of conidia are produced. (Witsch, H. v., and F. Wagner, 1955).

Alternaria solani. The fungus was given various doses of ultra-violet light from a Hanovia lamp. Within a few hours after irradiation conidiophores were visible and spores matured after 18 to 24 hours. (Charlton, K. M., 1953).

Alternaria solani. Five-week-old cultures on various media were subjected to continuous illumination by incandescent or fluorescent light (50 to 2100 f.c.), alternate light (8 hours) and dark (16 hours) periods, and darkness. While band spectrum limits were not considered, the peak of relative energy with incandescent light was between wave lengths of 610-730 mμ, whereas that of fluorescent light was 460-550 mμ. Room temperature and 26° C were used. Slow-speed fans were employed to minimize the radiant heat but dissipation of the heat energy from light striking the surface of the medium was not controlled. Illumination effected changes in conidial shape in all strains tested. The "typical muriform conidium" was consistently obtained in cultures incubated in continuous darkness and to a less extent in those subjected to diurnal variation. Under increasing light intensities the conidia produced were elongate and narrow. Under 1000 f.c. (fluorescent or incandescent source) the conidia were invariably attenuated. Light seemed to increase the tendency toward the formation of an attenuated once-branched rostrum. (Johnson, T. W., Jr., and J. E. Halpin, 1954).

Alternaria solani. Cultures which were scraped and placed on a window sill sporulated readily. Undisturbed cultures of most isolates of the fungus produced few or no spores. Cultures irradiated by an open mercury arc lamp sporulated abundantly. Irradiation through colored glass filters markedly affected sporulation. Greatest sporulation was obtained with filters whose lower limits of transmission ranged from 249-254 mμ. (McCallan, S. E. A., and S. Y. Chan, 1944).

Alternaria solani. Sporulation is induced by a high intensity of visible white light. Continued high light intensities increase pigmentation. (Weston, W. A. R. Dillon, 1936).

Alternaria sp. Germ tubes of conidia exposed to unilateral daylight illumination during germination showed no phototropic effect. (Robinson, W., 1914).

Alternaria tenuis. A culture subjected to diurnal changes of light and darkness showed zonation. Cultures under the same conditions of temperature but in continuous light or in continuous darkness showed no zones. Zones were produced in cultures in orange, red, or blue light alternating with darkness but not in those in continuous darkness under the same temperature conditions. (Gallemaerts, V., 1910).

Amphichaeta punicae. Fruit bodies were formed in darkness but not in light. (Chaudhuri, H., and J. Singh, 1935).

Ascochyta gossypii. The fungus produces abundant pycnidia when growing in complete darkness. Chlamydospores and hypnocysts are also produced, both in complete darkness and in light. (Chippindale, H. G., 1929).

Ascochyta imperfecta. Red clover isolates required light for sporulation on potato-dextrose agar and varied considerably in culture, while isolates from alfalfa sporulated under all conditions of light and darkness and were very uniform. (Schenck, N. C., 1955).

Ascochyta pisi. When 40 isolates of the fungus were grown in complete darkness, the sporulation in the cultures ranged from none to moderate. Under daylight and continuous fluorescent light all isolates sporulated profusely. The effective wave lengths were thought to be in the ultra-violet. (Leach, C. M., 1959).

Ascochyta viciae. Pycnidial formation was stimulated in diffuse daylight or under electric light in comparison with darkness. (Coons, G. H., and E. Levin, 1921).

Aspergillus fumigatus. Spinulosin (3:6-dihydroxy-4-methoxy-2:5-toluquinone) was isolated from the metabolic solution of cultures grown on Raulin-Thom medium for 25 to 26 days at 24° C in the dark. (Anslow, W. K., and H. Raistrick, 1938).

Aspergillus giganteus. When in darkness the fungus produced conidiophores 1 to 2 mm in height with small conidial heads, but in light it produced also giant conidiophores as long as 7 to 8 mm with clavate heads 1 mm or more long. Light sensitivity was confined to the lower half of the visible spectrum. (Gardner, E. B., 1949).

Aspergillus giganteus. Conidiophore elongation occurs so long as any white light is present but at low intensities the length of the induction period varies inversely as the intensity and is optimum at 5 f.c. Certain values are derived for the necessary length of light exposure before elongation starts and for the necessary length of the dark period which must precede the light period. Wave length of incident light was more important than intensity for the production of tall conidiophores, but intensity exerted proportionate effects when wave length was constant. The shorter visible wave lengths (those below 500 mμ) were most effective while those above this point were incapable of causing the reactions necessary for elongate growth. The near ultra-violet portion of the sub-visible spectrum was particularly effective in stimulating elongation, its relative effect being greater than could be accounted for by the increased energy value of the quanta in this region. (Gardner, E. B. W., 1950).

Aspergillus giganteus. The photic response to wave lengths between 400 and 500 mμ is apparently mediated by a yellow carotenoid, probably beta-carotene, as the light-absorbing substance. Sensitivity to wave lengths between 300 and 380 mμ may involve a colorless carotenoid which absorbs highly in this region of the spectrum. (Gardner, E. B., 1955).

Aspergillus giganteus. Higher intensities of light appear to give greater elongation of conidiophores. In direct unfiltered light short periods of light daily are almost as effective as long periods. Total darkness tends to retard conidiophore formation entirely. Conidiophores seem to be phototactic only so long as they are elongating. Once heads had started to form elongation ceased. Light of wave lengths longer than approximately 512 mμ did not seem to cause elongation. The critical wave length for elongation appeared to be between 470 and 512 mμ. Infra-red did not of itself cause elongation. (Webb, P. H. W., 1942).

Aspergillus glaucus. In darkness perithecia were produced abundantly and conidia only very sparsely. In light strong conidial formation occurred but few perithecia. The fluffy growth characteristic in darkness or subdued light is suppressed in strong light. (Chona, B. L., 1932).

Aspergillus glaucus. For summary see Eurotium herbariorum. (Gupta, D. D., 1951).

Aspergillus niger. See summary for Sterigmatocystis nigra. (Lendner, A., 1897).

Aspergillus ornatus (NRRL # 2256). The fungus produced few or no conidial heads in darkness, while heavy sporulation occurred in continuous white light of low intensity. When mycelium which has been incubated in the dark is placed in light, heavy sporulation occurs at the margin of the colony but not on the older parts. Illumination by a spectrum projected across a plate which had been uniformly inoculated with spores resulted in sporulation in blue light. (Personal communication from Dr. P. J. Allen.) (Raper, K. B., D. I. Fennell, and H. D. Tresner, 1953).

Aspergillus spp. The influence of natural and artificial light on 67 varieties of Aspergillus and Penicillium was studied. Transparent and darkened containers with sample cultures raised on agar media were exposed for 15 minutes to 24 hours to solar radiation, dispersed solar light, and electric light with intensities of 4500, 640, 180 and 120 lux. Temperature, humidity, aeration, and pH were held constant. Undispersed sun rays were filtered through distilled water to eliminate the effect of heat. Electric light was filtered through blue, red, green, and yellow light filters. Light inhibited the growth of mycelia and stimulated the development of conidia. Intense light retarded the ascomycetous stages in A. nidulans, A. repens, A. amstelodami, A. chevalieri and P. ucrainicum, and the development of sclerotia in A. carbonarius, A. alliaceus, A. candidus, A. flavus, and A. thomi. Weak light stimulated the development of conidia. Darkness stimulated the growth of mycelia, but protracted cultivation without light inhibited conidial development and yielded sterile and degenerated strains. Weak light increased the intensity of conidial formations in partly degenerated forms; this increased intensity was preserved in subsequent generations. Blue rays of electric light spectra retarded the development of mycelia, ascomycetous stages, sclerotia, and red, orange, and yellow pigments in P. rubrum, A. amylovorus, and P. purpurogenum. In contrast, red rays did not decolorize the pigments and did not inhibit mycelial, ascomycetous, and sclerotial development. Green and yellow rays produced intermediate effects. (Tatarenko, E. S., 1954).

Beauveria. Three isolates, one with the capacity to produce a yellow pigment, one blue-green, and the third, red, were studied. The yellow and blue-green pigments formed in light or darkness, but the red pigment formed only in light. (MacLeod, D. M., 1954).

Botryodiplodia theobromae. Cultures grown in darkness showed almost complete suppression of pycnidia, loss of greenish color in the mycelium, and an absence of stromata. Cultures exposed to daylight exhibited good stromatal development. In cultures with columnar fructifications, these were positively heliotropic. (Wardlaw, C. W., 1932).

Botrytis cinerea. The conidia germinated with unilateral lamplight at about 200 lux and showed strong negative phototropism. (Gettkandt, G., 1954).

Botrytis cinerea. The fungus formed conidia only at night, not in daylight. Red-yellow light (potassium dichromate filter) acted like darkness in permitting conidia to form, while blue-violet light (ammoniacal copper oxide) prevented conidial formation. (Klein, L., 1885).

Botrytis cinerea. Sclerotia are formed more freely in darkness than in the light. Spores are formed more freely in light. (Paul, W. R. C., 1929).

Botrytis cinerea. Cultures in the dark or red light (potassium dichromate filter) produced sclerotia but few conidia, whereas those under blue light (ammoniacal copper oxide) formed a thick layer of conidia as in white light. (Reidemeister, W. v., 1909).

Botrytis gladiolorum. Light affected sporulation, ridging, and sclerotial formation. With white fluorescent light for 7 hours or more, spore production increased with intensity. Following no more than 3 days of darkness, ridges were produced by a minimum of two 24-hour cycles of at least 8 hours of white fluorescent light and 1 hour of darkness. Sclerotia formed in cultures exposed to 4 to 7 days of darkness prior to an exposure of less than 30 minutes to white fluorescent light. Blue light and the shorter wave lengths appeared to accelerate sporulation and ridging. Red light favored sclerotial formation. (Bjornsson, I. P., 1956).

Botrytis gladiolorum. Petri dishes were inoculated and placed 1) in a window with direct illumination for about 4 hours per day; 2) in diffused light, and 3) in the dark. After 4 days

normal erect gray conidiophores developed in the dishes in direct light but not in the other two sets. (Peiris, J. W. L., 1949).

Botrytis sp. Germ tubes of spores germinated with unilateral daylight illumination grew away from the light. (Robinson, W., 1914).

Botrytis squamosa. When the fungus was exposed to a cycle of 12 hours in darkness followed by 12 hours in light, sclerotia were formed in zones. The light used consisted of daylight fluorescent lamps or the same in conjunction with incandescent bulbs. Temperature cycles in the dark also produced sclerotia in a zonate pattern. The author stated "Although the experiments were conducted under conditions in which temperature was rigidly controlled, it is difficult to eliminate the influence of light absorbed by the fungus and by the medium and transformed to heat." (Page, O. T., 1956).

Botrytis squamosa. When maintained at constant temperature the fungus was unaffected in growth and rate of respiration by light levels as high as 100 f. c. for several days and by levels of 250 f. c. for a few hours. (Stinson, R. H., R. S. Gage, and E. B. MacNaughton, 1958).

Camarosporium sp. When half of a plate culture was irradiated from an artificial untra-violet source and the other half protected from radiation, the irradiated half subsequently developed many more pycnidia. (Stevens, F. L., 1930a).

Centrospora acerina. Pigment production was a response to light. After 4 days' incubation in darkness, dishes were exposed to daylight for periods of 4 minutes to 8 1/2 hours. Two days later all light-exposed dishes showed a circle of red pigment and the width varied with the amount of exposure. (Neergaard, P., and A. G. Newhall, 1951).

Centrospora acerina. Growth and cultural characters of the fungus were studied at 21° C in darkness and in light from a fluorescent lamp. The fungus grew almost equally well under both conditions. Pigment was produced in the cultures in the light but not in those in the dark. Abundant spores were produced within 48 hours by irradiating with ultra-violet light. (Srivastava, S. N. S., 1958).

Cephalosporium sp. The fungus was exposed to a 450-watt General Electric sun-lamp at a distance of 50 cm for 1, 5, 15, 30, and 60 minutes on three consecutive days. The longer exposures inhibited the growth of the fungus colonies and caused them to take on a darker brown color. The fungus was not killed and sporulation was not materially altered. (Goss, R. W., and P. R. Frink, 1934).

Cephalothecium roseum. When cultures were kept in constant light and constant darkness, no zonation occurred. When they were subjected to alternating light and darkness with only slight variation in temperature, zonation occurred. The effect was found to be due to light, not to temperature, because in these experiments 9° C variation in temperature did not produce zonation. Zones were produced when cultures were grown in orange, red, or blue light alternating with darkness but not in cultures in continuous darkness under the same temperature conditions. (Gallemaerts, V., 1910).

Cephalothecium roseum. Zonation does not occur in total darkness. In red and orange light (daylight through liquid filter) alternating with darkness and in continuous darkness, uniform dense spore formation occurred over the entire surface of the medium. When blue light and ordinary light were alternated with darkness (natural diurnal cycle) distinct daily rings of alternating dense and sparse spore formation occurred. Green light in the same cycle produced less distinct rings of growth. Rings of sparse spores were formed during the day and the denser ones at night. Blue light inhibited spore formation. (Hedgecock, G. G., 1906).

Cephalothecium roseum. Ring formation could be brought about by a change in temperature or by passing a stream of air over the cultures. The action of light was considered to be indirect. (Munk, M., 1912).

Cercospora apii. The fungus was grown in darkness in a ventilated metal chamber, in the diffuse light of the laboratory, and in a dark room with a 50-watt Mazda bulb. Light effects

were not very marked. On corn meal agar in the dark the aerial mycelium was slightly darker gray. The fungus sporulated in light and darkness. (Klotz, L. J., 1923).

Cercospora beticola. Blue light was comparable with diffuse daylight in the production of zonation, but red light induced only traces of zonation. (Coons, G. H., and F. G. Larmer, 1930).

Cercospora beticola. Conidia were produced in flask cultures on sterilized beet, white cabbage, and leek leaves with a substratum of soil (compost or sand). They were formed as freely in total darkness as in light. (Frandsen, N. O., 1953).

Cercospora beticola. Three strains of the fungus were grown in complete darkness for 11 days at 20° C. A red and a yellow pigment were produced in darkness and also when the cultures were incubated with a normal daylight-darkness sequence. These results may be contrasted with those of Neergaard and Newhall (1951), who found Centrospora acerina (regarded by Frandsen as a Cercospora) very light-dependent in respect to pigment production. (Frandsen, N. O., 1955).

Cercospora sesami. The rate of linear growth was found to be greater in alternate light and darkness, less in continuous darkness, and least in continuous light. The retarding effect of continuous darkness and continuous light became more evident with time. Distinct zones were formed in cultures kept outside exposed to light during the day and to darkness during the night, but cultures in continuous light or continuous darkness showed no zones. Continuous light or continuous darkness inhibited sporulation while cultures in alternating light and darkness sporulated earlier and more copiously. When cultures which had been kept in darkness were exposed to light, spore formation was stimulated. (Chowdhury, S., 1944).

Cercospora sp. Five-week-old cultures on various media were subjected to continuous illumination by incandescent or fluorescent light (50 to 2100 f. c.), alternate light (8 hours) and dark (16 hours) periods, and darkness. The treatments had no influence on conidial production. (Johnson, T. W., Jr., and J. E. Halpin, 1954).

Cercospora spp. Cultures in dishes exposed to daylight sporulated more abundantly than did those in dishes incubated in darkness; however, darkness did not suppress sporulation completely. (Kilpatrick, R. A., and H. W. Johnson, 1956).

Cercosporella herpotrichoides. Spores formed as rapidly and as freely in darkness as in the daylight. (Glynne, M. D., 1953).

Cercosporina kikuchii. The fungus formed a red-violet pigment in daylight or artificial light but not at all in darkness. When cultures grown in the dark were transferred into light, pigment formed. Pigment formation depended on an acid reaction of the substrate and presence of light and oxygen. (Deutschmann, F., 1953).

Colletotrichum falcatum. Cultures under white and blue light showed abundant sporulation and those in red light less. Cultures in darkness produced the most aerial mycelium but the fewest spores. (Kreitlow, K. W., 1938).

Colletotrichum lagenarium. Perithecia were produced abundantly by ultra-violet irradiation. There were more setae per acervulus on the irradiated side of the colony than on the non-irradiated side. (Stevens, F. L., 1931b).

Colletotrichum lindemuthianum. Sporulation did not appear to be influenced by variations of daylight, ultra-violet light, or aeration. (Mathur, R. S., H. L. Barnett, and V. G. Lilly, 1950).

Colletotrichum phomoides. About 24 hours after irradiation, cultures (half irradiated and half not exposed to irradiation) showed numerous acervuli, mostly in clumps, in the irradiated half while the non-irradiated half remained free from acervuli until about 8 days old. Maximum development of acervuli resulted from exposures of 30 seconds to 1 minute; longer exposures accelerated formation of acervuli, but they were produced in smaller quantities. (Hutchinson, A. H., and M. R. Ashton, 1930).

Colletotrichum sp. When half of a plate culture was irradiated from an artificial ultra-violet source and the other half protected from radiation, the irradiated half subsequently developed many more acervuli. (Stevens, F. L., 1930a).

Colletotrichum trifolii. Cultures in the light grew at practically the same rate as those in darkness. Spore germination was essentially identical in light and dark chambers. (Monteith, J., Jr., 1928).

Coniothyrium concentricum. Pycnidia were formed in light and in darkness. (Leonian, L. H. 1924).

Coniothyrium fuckelii. Parallel series were grown on copper-containing and copper-free media. Growth rates for isolate #1 were identical in both series when supplied with thiamin and kept in light. In darkness growth was normal only when the isolate had been grown on a copper medium previously. On the medium containing biotin, thiamin and i-inositol growth was normal in darkness whether or not the fungus was previously grown on copper. (King, T. H., E. Krog, and H. W. Schroeder, 1952).

Coniothyrium sp. Eight-day-old colonies were irradiated with a Hewitt quartz mercury arc for periods ranging from 1 second to 3 minutes. With 1 second there was very slight stunting, which became distinct at 5 seconds. With 10 seconds' exposure numerous superficial or buried pycnidia were formed. (Stevens, F. L., 1928).

Coryneum longistipitatum. Cultures at 24° to 27° remained sterile in darkness and subdued light. They may be stimulated to sporulate by the action of sunlight. (Zagallo, A. C., 1941).

Curvularia lunata. Five-week-old cultures on various media were subjected to continuous illumination by incandescent or fluorescent light (50 to 2100 f. c.), alternate light (8 hours) and dark (16 hours) periods, and darkness. (For other conditions, see Alternaria solani, Johnson and Halpin, 1954.) In general, sporulation occurred earlier under illumination than in darkness. Sporulation under light began 13 to 16 hours after incubation began, while cultures incubated in the dark began sporulating after 41 hours. (Johnson, T. W., Jr., and J. E. Halpin, 1954).

Curvularia trifolii. Cultures in continuous white fluorescent light produced an abundance of spores while those in darkness produced only a few. In an experiment in which light was varied from 1 to 24 hours by hourly intervals, certain cultures receiving cycles of 8 to 11 hours of light per day showed a striking zonation, while in cultures receiving over 16 hours of light alternating with 8 hours of darkness zonation did not occur. (Bjornsson, I. P., 1956).

Cytosporella mendax. Pycnidia formed in both light and darkness. (Leonian, L. H., 1924).

Dendrophoma obscurans. Cultures on nutrient agar were incubated in a constant temperature room at 25° C in continuous light, in continuous total darkness, and in 12-hour light-dark cycles using white, blue, green, yellow, and red light of known wave length. No pycnidia formed in the absence of light or under red light in the 12-hour cycle, while many pycnidia and conidia were produced under white and blue light in the 12-hour light-dark cycle and under continuous white light. Few pycnidia and conidia were produced under green and yellow light in the 12-hour cycle. (Barnett, H. L., and V. G. Lilly, 1953).

Dendrophoma obscurans. When the fungus was grown in continuous darkness extremely few pycnidia were formed, but when it was grown in constant artificial illumination or in alternate light and darkness at the same temperature large numbers were produced. (Lilly, V. G., and H. L. Barnett, 1951).

Diplodia gossypii. Cultures were grown in darkness and in continuous light of different qualities. Pycnidia did not form in cultures in the dark but formed under all light conditions. Cultures under red fluorescent lamps with two red filters produced fewer, larger, and longer-necked pycnidia than did those under other light conditions. (Bjornsson, I. P., 1956).

Diplodia gossypina. The experimental methods employed and the results obtained are the same as for Camarosporium sp. (Stevens, F. L., 1930a).

Epicoccum spp. Several cultures were shown to produce a pinkish or red color in oatmeal agar in response to exposure to bright sunlight or strong artificial light when temperature was not controlled. (Schol-Schwarz, M. B., 1959).

Fusarium bulbigenum. Exposure to sunlight favored the production of long conidia, as compared with those formed in darkness. Light from an incandescent lamp induced the formation of macroconidia; microconidia formed in darkness. (Harter, L. L., 1939).

Fusarium cepae. Spore production was definitely stimulated by exposure to ultra-violet radiation from a quartz mercury arc. Greatest spore production occurred with filters with transmission between 2535-2800 Å. Long exposure to direct sunlight through filters transmitting no lower than 3120 Å induced abundant sporulation. (Ramsey, G. B., and A. A. Bailey, 1930).

Fusarium cepae. Conidial color varied from light brown when in darkness to ochraceous salmon or light ochraceous buff when in diffuse light. (Walker, J. C., and E. C. Tims, 1924).

Fusarium coeruleum. The fungus showed no difference in growth in light or darkness. (Buxton, E. W., 1955).

Fusarium coeruleum. The experimental methods employed and the results obtained are similar to those for F. bulbigenum. (Harter, L. L., 1939).

Fusarium culmorum. Two hitherto undescribed crystalline coloring matters, "rubrofusarin" ($C_{15}H_{12}O_5$, m.p. 210-211°, glistening red plates) and "aurofusarin" ($C_{30}H_{20}O_{12}.H_2O$, m.p. above 360°, orange-yellow prisms), were isolated from cultures grown in the dark at 24° C on Raulin-Thom medium. (Ashley, J. N., B. C. Hobbs, and H. Raistrick, 1937).

Fusarium culmorum. The fungus showed no difference in growth in light and darkness. (Buxton, E. W., 1955).

Fusarium culmorum. Cultures were given one irradiation for different periods of time with light from a sun lamp. The primary reaction was retardation. Subsequently, however, these irradiated cultures sporulated very abundantly whereas the non-irradiated cultures sporulated sparsely. (Weston, W. A. R. Dillon, 1932).

Fusarium discolor sulphureum. Cultures from a dark incubator were exposed to bright daylight for only 1/4 to 1/2 second. A ring of conidia was produced visible to the naked eye. Cultures kept in the dark produced no rings. A 6-minute exposure to a 25-candlepower carbon lamp produced a noticeable ring, while 2-to 2 1/2-minutes' exposure to a tungsten filament induced zone formation. (Bisby, G. R., 1925).

Fusarium episphaeria. Pigment (different shades of orange) developed only in light. (Zachariah, A. T., H. N. Hansen, and W. C. Snyder, 1956).

Fusarium eumartii. Spore production was stimulated by a very short exposure to ultra-violet light from a mercury arc lamp. (Smith, E. C., 1935).

Fusarium fructigenum. The fungus must have alternating light and darkness for the production of zones. Exposure to light promoted a sporiferous type of growth in contrast to the sterile type obtained in darkness. (Hall, M. P., 1933).

Fusarium lateritum. Pigment (pinkish tint) developed only in light. Bluish patches were present in cultures grown in light or in darkness. (Zachariah, A. T., H. N. Hansen, and W. C. Snyder, 1956).

Fusarium martii var. pisi. The experimental methods employed and the results obtained are similar to those for F. bulbigenum. (Harter, L. L., 1939).

Fusarium moniliforme. Five-week-old cultures were subjected to continuous illumination by incandescent or fluorescent light (50 to 2100 f.c.), alternate light (8 hours) and dark (16 hours) periods, and darkness. For other conditions see Alternaria solani. The treatments did not influence conidial production. (Johnson, T. W., Jr., and J. E. Halpin, 1954).

Fusarium moniliforme (ATCC # 10052). Sporulation occurred readily under all light conditions and in darkness. Light was necessary for the production of pigment; the intensity of the color increased as light intensity was increased. Pigment was restricted to those areas of the mycelium which had received the light treatment. Cultures become sensitive to light on the second day after inoculation. The lowest intensity which would induce pigmentation was 150 f.c. with an illumination period of 34 minutes, and the shortest illumination period which would induce pigmentation was 17 minutes at 800 f.c. (Wishard, R. H., 1957).

Fusarium moniliforme. Pigment (pinkish tint) developed only in light. Optimum requirements for typical development were diurnal fluctuation in light and fluctuating temperature of 20° -23° C. (Zachariah, A. T., H. N. Hansen, and W. C. Snyder, 1956).

Fusarium oxysporum. Cultures were grown in continuous light (fluorescent) and continuous darkness for 20 days. The dark cultures exhibited a deep vinaceous-purple color with sparse cottony aerial mycelium. Macroconidia (straight) were rare, but chlamydospores (spherical) were common. Pionnotes and sclerotia were absent. In the light cultures were orange with very sparse aerial mycelium. Macroconidia (curved) were abundant, but chlamydospores (oval) were very rare. Pionnotes were abundant and dark-blue sclerotia were common. Under blue light (15 days) cultures were orange with abundant pionnotes but no sclerotia. Under red light (15 days) cultures were pale vinaceous with no pionnotes or sclerotia. (Buxton, E. W., 1955).

Fusarium oxysporum. Cultures on a wide variety of media were incubated at constant temperature under light and dark conditions. Light promoted the formation of orange (carotenoid) pigments and of macrospores, whereas darkness favored the formation of diffusible red and purple (naphthoquinone) pigments and chlamydospores. Dark-grown cultures have not been known to produce sporodochia or sclerotia. Three-day-old cultures were exposed to a mercury-vapor lamp; the temperature was kept at 20° -21° C. Exposure for 1 hour produced perceptible pigmentation and exposure for 10 hours, a strong color. Most coloration occurred in darkness during the 24 hours following irradiation and was limited to the mycelium that was irradiated. New growth was colorless. (Carlile, M. J., 1956).

Fusarium oxysporum. Pigment (pinkish tint) developed only in light. (Zachariah, A. T., H. N. Hansen, and W. C. Snyder, 1956).

Fusarium rigidiuscula. The fungus showed pronounced zonation when grown under fluctuating light or fluctuating temperature. Pigmentation (rose) was more conspicuous in cultures grown in darkness as compared with that of those grown in light. Sporulation occurred under all conditions except in the series in darkness, but spores produced under most of these conditions showed abnormalities. (Zachariah, A. T., H. N. Hansen, and W. C. Snyder, 1956).

Fusarium roseum. The fungus had pronounced zonation when grown under fluctuating light or fluctuating temperature. It had more conspicuous pigmentation (rose) in darkness than in light. It developed perithecia under various conditions, the cultures exposed to fluctuating light and continuous temperature of 20° C producing them in abundance. (Zachariah, A. T., H. N. Hansen, and W. C. Snyder, 1956).

Fusarium solani. The fungus exhibited pronounced zonation when grown under fluctuating light or fluctuating temperature. It showed abundant sporulation under all conditions studied and produced sporodochia or pionnotes in complete darkness at a constant temperature of 20° C. As compared with cultures exposed to light, those in darkness showed more conspicuous pigmentation (olive green). (Zachariah, A. T., H. N. Hansen, and W. C. Snyder, 1956).

Fusarium sp. (six strains). In general, the aerial mycelium of cultures kept in alternating day and night is short-lived. In its place are pustules of spores (sporodochia), which show a distinct tendency to zonal arrangement and are definitely correlated with alternation of light and darkness. When cultures are grown in darkness the aerial mycelium lasts longer and covers the whole plate, the amount of sporulation is reduced. When subsequently exposed to light some of the mycelium develops spores. Upon a short exposure to light, spore production will be initiated and the formation of spores will then take place in darkness. The region of greatest sensitivity to light is a short distance behind the growing margin of the colony. The

rate of growth of the colony was not appreciably affected by variation of the conditions of illumination. Cultures grown in light had a slight pink color. (Brown, W., 1925).

Fusarium sp. Cultures at room temperature were exposed to diffuse daylight. Sporulation was more profuse and normal under these conditions. (Oswald, J. W., 1949).

Fusarium spp. Fifty-nine species were exposed to ultra-violet rays between 2650 and 2300 Å. In most species sporulation increased, and sometimes pigmentation in the mycelium did also. A marked increase in macrospore percentage was noticed in several species after three daily 15-minute treatments under vita-glass (transmitting up to 2650 Å). Some other species gave favorable although not such striking results in macrospore increase while many species showed little or no macrospore increase after irradiation. With very few exceptions, the tendency to respond or not respond to irradiation with macrospore production was consistent and seemed characteristic of the species or variety. The most extensive spore production induced by irradiation occurred in species of sections Sporotrichiella, Gibbosum, Discolor subsection Saubinetti, Martiella, and Elegans subsection Oxysporum (excluding vascular parasite group). Initiation of sporulation in F. culmorum was hastened. A strain of F. coeruleum which had never produced conidia during its period of culture in this laboratory and one of F. sambucinum the activity of which was in abeyance were induced to sporulate. One strain of Fusarium (section Gibbosum) which had never produced spores in the laboratory produced many spores when irradiated. Most species tested gave maximum macrospore production under vita-glass. A 15-minute irradiation period on each of 3 successive days was better than one longer period. In responsive species old cultures (filling the dish) could be made to produce macrospores by irradiating them. Neither three 15-minute exposures through vita-glass at 40 cm from the arc nor three (or fewer) 4-second direct exposures at 21 cm from the arc succeeded in inducing the production of perithecia of the 14 species with known perfect stages which were treated in these tests. (Bailey, A. A., 1932).

Fusarium spp. Cultures grow equally well in light or darkness, but the colors produced are much more vivid in rather bright light. (Bisby, G. R., 1917-1920).

Fusarium spp. Exposure to light from an incandescent lamp increased the size and number of septations of the conidia. (Harter, L. L., 1941).

Fusarium spp. On lima bean agar the fungus shows no difference in cultures in a dark incubator and in diffuse light. On potato-glucose agar a more intense purple color appeared when the fungus was grown in the light incubator than when it was grown in the dark incubator. Cultures in darkness developed conidia with uneven septations and form. (Morris, H. E., and G. B. Nutting, 1923).

Fusarium spp. A number of Fusarium species were studied. Light affected macrospore production in a number of species. Macrospore production and the ratio of macrospores to microspores increased with increasing light intensity. Both carbon and nitrogen sources were also important in determining the kind and amount of sporulation in the species tested. Colony growth was appressed in light, and pigmentation of the mycelium often was produced in response to light. (Reid, J., 1958).

Fusarium spp. Three species were grown in light and darkness. Single-spore cultures subjected to light only for the first 4 days of growth failed to develop in the same manner as those allowed to remain in light. Such characters as color, zonation, type of colony, presence or absence of sporodochia, size, shape and septation of macroconidia, and even the occurrence of a perithecial stage, cannot be used successfully in taxonomy unless these fungi are grown in adequate light. (Snyder, W. C., and H. N. Hansen, 1941).

Fusarium tricinctum. Pigment (pinkish tint) developed only in light. Optimum requirements for typical development were diurnal fluctuation in light and a temperature fluctuating within narrow limits but never higher than 20° C. The fungus failed to sporulate under any environmental conditions in this experiment. (Zachariah, A. T., H. N. Hansen, and W. C. Snyder, 1956).

Fusicladium cerasi. Light, either daylight exposure in the laboratory or artificial light in an incubator, hastened the production of conidia. (Schweizer, H., 1958).

Gliocladium roseum. Isolates tested produced a yellow pigment when they were grown on corn meal agar in the absence of light. When they were cultured on corn meal agar and exposed to daylight they produced a pink pigment. Cultures incubated in darkness for 36 to 72 hours produced a yellow pigment, but when these cultures were then exposed to daylight for 24 hours or more the pigment changed to pinkish-orange. (Huber, D. M., and A. M. Finley, 1959).

Gliocladium roseum. The fungus grew as rapidly and produced conidia as abundantly in darkness as in light. When it was incubated in darkness the subaerial mycelium and spore masses remained white, but when it was exposed to daylight they assumed normal salmon-pink color and the younger parts of colonies began to show typical concentric zonation. (Isaac, I., 1954).

Helicodendron triglitziensis. This fungus, if kept in light for a few days, sporulates over the entire surface of the colony. If kept in darkness it never sporulates. (Glenn-Bott, J. I., 1955).

Helicodesmus albus. Culture experiments indicate that conidium production depends on light. Four tubes were placed in a light-tight box, and four were left outside as close to the box and under conditions otherwise as nearly the same as possible. At the end of 2 weeks the exposed cultures had produced a white zoned veil of spores, while the cultures in the dark had made abundant mycelial growth with but very few spores around the point of inoculation. (Linder, D. H., 1925).

Helminthosporium avenae. Cultures were grown in two Petri dishes. Three days later the covers of the Petri dishes were replaced with discs of Sanalux glass. One-half of each disc was painted with India ink. Both cultures were then irradiated for 10 minutes with a Hanovia quartz mercury-vapor lamp. Subsequent irradiation was made for 10 minutes, 6 days later. Seven days later cultures were examined microscopically. The mycelia of irradiated halves were strongly pigmented and abundant sporulation had taken place. Pigmentation was very slight on the non-irradiated halves and no sporulation had taken place. (Weston, W. A. R. Dillon, 1933).

Helminthosporium avenae. The fungus sporulated abundantly when exposed to visible white light of high intensity. Continued high light intensities increase pigmentation. (Weston, W. A. R. Dillon, 1936).

Helminthosporium cyclops. For summary see Podosporiella verticillata. (Wallace, H. A. H., 1959).

Helminthosporium gramineum. Abundant normal sporulation was obtained within 48 hours on agar cultures held outdoors to expose them to diurnal changes of environment. In the absence of light no sporulation occurred on agar slants or on mycelium growing from diseased leaves either outdoors or indoors. In light but under continuous high indoor temperatures, again, no sporulation was obtained. Light, preferably outdoor daylight, was necessary for the induction of sporulation. Relatively high temperatures throughout the growing period as well as extended periods of light resulted in excessively long conidiophores, few of which produced conidia. This was true of agar cultures and of pieces of diseased leaves. A temperature drop during half of each 24-hour period gave best results. When diseased leaf pieces were placed on potato-dextrose agar and incubated in the dark at various temperatures from 8° to 35° to obtain sporulation, conidiophore length increased and conidium length decreased as the temperature increased. (Houston, B. R., and J. W. Oswald, 1946).

Helminthosporium leersii. When the fungus was grown in darkness, two hitherto undescribed mold metabolic products, namely "luteoleersin", $C_{26}H_{38}O_7$ (yellow blunt-ended needles), and "alboleersin", $C_{26}H_{40}O_7$ (colorless silky needles), were isolated in crystalline form. (Ashley, J. N., and H. Raistrick, 1938).

Helminthosporium sativum. Conidia were produced abundantly in cultures incubated in continuous darkness. (Christensen, J. J., 1926).

Helminthosporium sativum. Five-week-old cultures on various media were subjected to continuous illumination by incandescent or fluorescent light (50 to 2100 f. c.), alternate light (8 hours) and darkness (16 hours) periods, and darkness. For other conditions see Alternaria solani. Illumination effected changes in conidial shape in all strains tested. Conidia produced in cultures exposed to incandescent and fluorescent light at 500 f. c. were characteristic of those produced on the host. Conidia in cultures incubated continually in darkness were invariably shortened and aborted. The majority of conidia produced by colonies exposed to 50 and 100 f. c. and to alternate light (intensities up to 500 f. c.) and darkness were short, single-celled or at most biseptate, but were not aborted as were those from cultures incubated in darkness. At 200 f. c. conidia approached the size of "typical" ones but usually possessed fewer septa. Sporulation occurred earlier under illumination than in darkness. (Johnson, T. W., Jr., and J. E. Halpin, 1954).

Hendersonia sp. Light was necessary for pycnidial formation. (Leonian, L. H., 1924).

Hormodendron cladosporoides. Cultures were left for 14 days in a controlled-temperature room in continuous light and in continuous darkness. No zonation occurred. The cultures were then placed in the laboratory and after 3 days of exposure to alternating daylight and darkness three very distinct zones were observed. In another experiment, cultures submitted to alternating daylight and darkness produced zones, but cultures under the same temperature conditions in continuous light or continuous darkness produced no zones. Zones were produced when cultures were grown in orange, red, or blue light alternating with darkness but not in cultures grown in continuous darkness under the same temperature conditions. (Gallemaerts, V., 1910).

Hormodendron sp. Zonation does not occur under conditions of total darkness. In red and orange light (daylight through liquid filter) alternating with darkness and in continuous darkness uniform dense spore formation occurred over the entire surface of the medium. When blue and ordinary light were alternated with darkness (natural diurnal cycle) distinct daily rings of alternating dense and sparse spore formation occurred. Green light in the same cycle produced less distinct rings of growth. Rings of sparse spore formation were formed during the day and denser ones at night. Blue light inhibits spore formation. (Hedgecock, G. G., 1906).

Isaria farinosa. This fungus was identified as Isaria farinosa or a fungus closely resembling it. Coremia subjected to unilateral illumination grew directly toward the light source. (Schaposchnikow, W., and A. Manteifel, 1924).

Isaria virescens. The fungus can form at least seven different pigments under different conditions of culture media and light. On sugar-peptone agar, cultures grown in darkness are colorless, whereas the same cultures in diffuse daylight are reddish or orange-red. (Danilov, A. N., 1925).

Kellermania yuccagena. Pycnidia were formed in both light and darkness. (Leonian, L. H., 1924).

Macrophomina phaseoli. Thirty-five isolates of the fungus were studied for factors influencing pycnidium formation. Complete darkness inhibited sporulation in all cases. Diurnal exposure to light was more favorable than constant light. (Ashworth, L. J., Jr., 1959).

Macrosporium tomato. Spore production is definitely stimulated by exposure to ultra-violet radiation from a quartz mercury arc. Greatest spore production occurs with filters with transmission between 2535-2800 Å. Long exposure to direct sunlight through filters transmitting no lower than 3120 Å induced abundant sporulation. (Ramsey, G. B., and A. A. Bailey, 1930).

Melanconium fuligineum. Cultures sporulated equally well in light or darkness. (Timnick, M. B., V. G. Lilly, and H. L. Barnett, 1951b).

Microcera coccophila. Formation of coloring matter in the mycelium is provoked by the action of diffused daylight upon cultures which have grown in darkness, but the pigmentation of the conidia is a fixed characteristic unrelated to environment and due to the genetic constitution of the species. (Pulselli, A., 1927).

Monilia fructicola. Under different light intensities, photoperiods, and photocycles, the growth of the conidiophores of the fungus depends on the amount of light energy received. Conversion to the conidial phase is a function of the quantity of energy furnished by a photocycle of 1 hour within the range of 20-200 lux-min/hr. (Jerebzoff, S., 1958).

Monilia fructicola. Low temperatures favor and prolong the growth in height of conidiophores which begin to grow in darkness in the same way as it does the elongation of their cells, but strongly reduces sporulation. Light (even of short duration -- 1 hour) furnished before the application of low temperatures or 2 days afterward inhibits totally or partially the said prolonged growth. (Jerebzoff, S., 1959).

Monilinia fructicola. The fungus sporulates freely under red or far red light or in darkness. (McClellan, W. D., H. A. Borthwick, I. Bjornsson, and B. H. Marshall, Jr., 1955).

Naemosphaera sp. Pycnidia were formed in both light and darkness. (Leonian, L. H., 1924).

Nigrospora sphaerica. Spore discharge took place in all directions from the surface even when illumination was unilateral. Spore discharge also occurred in darkness. (Webster, J., 1952).

Oidiodendron fuscum. The fungus was grown in darkness and from the growth medium there was isolated a hitherto unreported metabolic product, "fuscin" ($C_{15}H_{16}O_5$, orange plates, m.p. 230°), accompanied by its reduction product, "dihydrofuscin" ($C_{15}H_{18}O_5$, colorless rhombic crystals, m.p. 206°). (Michael, S. E., 1948).

Ollula sp. Pycnidia were formed in both light and darkness. (Leonian, L. H., 1924).

Penicillium africanum. The fungus produced a red coloring material in both light and darkness. (Doebelt, H., 1909).

Penicillium album. Zonation does not occur under conditions of total darkness. In red and orange light (daylight through a liquid filter) alternating with darkness, and in continuous darkness uniform dense spore formation occurred over the entire surface of the medium. When blue light and ordinary light were alternated with darkness (natural diurnal cycle) distinct daily rings of alternating dense and sparse spore formation occurred. Green light in the same cycle produced less distinct rings of growth. Rings of sparse spores were formed during the day and denser ones at night. Blue light inhibits spore formation. (Hedgecock, G. G., 1906).

Penicillium claviforme. The coremia are markedly phototropic. (Raper, K. B., and C. Thom, 1949).

Penicillium cyclopium. When incubated at 24° C in the dark, the fungus formed pigment erratically, the growth obtained was often white with little color in the reverse. Exposure to light appears to be essential for maximum pigment production. Optimum conditions were met by incubating the flasks in the laboratory at an average temperature of 20°-21°. Under these conditions about five times as much coloring matter was isolated as from the duplicate flasks incubated at 24° in darkness. Emodic acid and gamma-hydroxyemodin were isolated from the mycelium. (Anslow, W. K., J. Breen, and H. Raistrick, 1940).

Penicillium funiculosum. The fungus produces an orange-red color when grown in daylight. When it is grown in darkness the coloration is much weaker and delayed. (Ebeling, R., 1938).

Penicillium gladioli. Cultures were grown in continuous white, blue, green, and red fluorescent lights and in darkness. Cultures receiving white and blue light were covered with spores and aerial mycelium was absent; those receiving green light were also covered with spores, but some aerial mycelium was present. Cultures in red light and in darkness developed very few spores but a great amount of aerial mycelium. (Bjornsson, I. P., 1956).

Penicillium glaucum. Cultures submitted to variations of light are zoned. Zones were produced when cultures were grown in orange, red, or blue light alternating with darkness but not in cultures grown in continuous darkness under the same temperature conditions. (Gallemaerts, V., 1910).

Penicillium glaucum. The germ tubes from spores germinated with a unilateral source of daylight illumination exhibited no phototropic response. (Robinson, W., 1914).

Penicillium herquei. When grown in total darkness or at high light intensities (over 200 f.c.) the organism failed to sporulate. However, it sporulated rather abundantly at 100 f.c. Yellow colonies exposed to sunlight rapidly turn green. The results indicated that the reaction was a photocatalytic oxidation, perhaps mediated by a fluorescent pigment. They also indicated that the living organism possessed the ability to reverse the color change, that is, green to yellow. (Riedhart, J. M., and C. L. Porter, 1958).

Penicillium isariaeforme. Coremia are strongly positively phototropic. (Stolk, A. C., and J. Meyer, 1957).

Penicillium islandicum. (NRRL # 1175). The fungus was grown in darkness and several coloring materials were chromatographically separated. One of these was chrysophanic acid (chrysophanol, 4:5-dihydroxy-2-methyl-anthraquinone). (Howard, B. H., and H. Raistrick, 1950).

Penicillium islandicum. (NRRL # 1175). The fungus was grown in darkness and two hitherto undescribed coloring materials, namely "skyrin" ($C_{30}H_{18}O_{10}$, orange-red rods or yellow hexagonal plates, m.p. above 380°), and "flavoskyrin" ($C_{15}H_{12}O_5$, yellow needles, m.p. 215° (decomp.)), were isolated. (Howard, B. H., and H. Raistrick, 1954).

Penicillium luteum. Cultures were incubated under five different conditions: 1) diffuse daylight on a laboratory table, 2) constant darkness, 3) daylight through a blue liquid filter, 4) daylight through a yellow liquid filter, and 5) a cycle of 2 days' darkness-2 hours' daylight-3 days' darkness-2 hours' daylight repeated for a period of 23 days. All colonies showed the same total diameter of growth. In 1) there were 23 rings, corresponding to the number of days of the experiment. The same thing occurred in 3), that is, blue light acted like daylight. In 2) and 4) no ring formation occurred. In 5) there were rings of more translucent zones corresponding to the long dark periods alternating with more dense zones corresponding to the light periods. Light was necessary for conidial formation. (Knischewsky, O., 1909).

Penicillium luteum. Cultures of old degenerate strains (sterile aerial mycelium) of the fungus formed typical conidiophores after a few hours' exposure to bright light. (Smith, G., 1946. p. 221).

Penicillium nalgiovensis. The fungus was grown in darkness and two hitherto undescribed coloring materials, namely "nalgiovensin" ($C_{18}H_{16}O_6$, orange needles or plates, m.p. 199-200°) and "nalgiolaxin" ($C_{18}H_{15}O_6Cl$, yellow needles or plates, m.p. 248-248.5°), were isolated. (Raistrick, H., and J. Ziffer, 1951).

Penicillium schneggii. The fungus produced an orange pigment in both light and darkness. Color production was much dependent on the nature of the carbon source. Coremia are positively heliotropic. (Boas, F., 1914).

Penicillium sclerotiorum. The fungus was grown in darkness and a chlorine-containing substance, "sclerotiorine" ($C_{20}H_{20}O_5Cl$), was extracted from the mycelium. Growth in darkness resulted in greater production of pigment and mycelium than did growth in light. (Curtin, T. P., and J. Reilly, 1940).

Penicillium sp. In constant darkness many conidia were formed and growth was uniform. In constant light (900 lux) production was uniform, but fewer conidia were produced than in constant darkness. Light limited the number of conidia produced but did not inhibit production. White light (900 lux) in a 12-hour light-dark cycle produced zonation (a concentration of conidia alternating with few conidia); the effect was related to intensity. Tests on intensity showed the lower limit of effectiveness to be 6 lux. Far-red, red, and orange light had no effect on

conidial formation, but long ultra-violet, green, and blue light (390-530 mμ) had a definite effect. (Sagromsky, H., 1952a).

Penicillium sp. In a 12-hour light-dark cycle definite zonation occurred. Conidia-rich areas were produced in darkness and conidia-poor areas in light. Light suppressed conidial formation. A green color which was principally confined to the conidia was produced. (Sagromsky, H., 1952b).

Penicillium spp. For summary see Aspergillus spp. (Tatarenko, E. S., 1954).

Pestalotia guepini. Pycnidia were formed in both light and darkness. (Leonian, L. H., 1924).

Pestalotia sp. The fungus sporulated freely under fluorescent, mazda, or blue light but not under red or far-red (about 7000 Å and above) light or in darkness. A mutant of the fungus sporulated freely under all light conditions tested. (McClellan, W. D., H. A. Borthwick, I. Bjornsson and B. H. Marshall, Jr., 1955).

Phoma apiicola. Pycnidia formed in both light and darkness. (Bennett, C. W., 1921).

Phoma herbarum var. medicaginis. Isolates were studied for their ability to sporulate on potato-dextrose agar in total darkness, in alternating light and darkness, and in continuous light. After 14 days the fungus had sporulated uniformly under all light conditions. (Schenck, N. C. and J. W. Gerdemann, 1956).

Phoma insidiosa. When grown on corn meal agar in light, the fungus produced a pink discoloration of the medium. This was especially marked in plates exposed to light just after germination of the conidia. Each conidium was the center of a pink spot. If the culture was left undisturbed for several days, a series of concentric pink and white circles radiating from the conidium formed. A count showed the white circles marked the spaces traversed by the hyphae during the night, the pink circles during the day. The pink color faded as the culture aged. Old and slowly growing mycelium did not produce the color. (Koch, E., and C. Rumbold, 1921).

Phoma trifolii. Isolates from red clover required light for sporulation on potato-dextrose agar and varied considerably in culture. Isolates from alfalfa sporulated under all conditions of light and darkness and were very uniform. (Schenck, N. C., 1955).

Phoma trifolii. Isolates were studied for their ability to sporulate on potato-dextrose agar in total darkness and in continuous light. After 14 days the fungus had sporulated well in continuous light, only fairly well in alternating light and darkness, and not at all in total darkness. (Schenck, N. C. and J. W. Gerdemann, 1956).

Phoma urens. Pycnidia formed in both light and darkness. (Leonian, L. H., 1924).

Phomopsis sp. Pycnidial formation occurred after 20 to 25 days and was accelerated by ultraviolet irradiation. The pycnidia produced under these conditions were smaller than normal. (Abe, T. and C. -T. Yeh, 1956).

Phomopsis vexans. The experimental methods employed and the results obtained are the same as for Camarosporium sp. (Stevens, F. L., 1930a).

Phyllosticta shaminella. The experimental methods employed and the results obtained are similar to those for Camarosporium sp. (Stevens, F. L., 1930a).

Phyllosticta solitaria. The fungus sporulated equally well whether the cultures were kept in light or darkness. (Mix, A. J., 1933).

Piricularia oryzae. Five-week old cultures on various media were subjected to continuous illumination by incandescent or fluorescent light (50 to 2100 f.c.), alternate light (8 hours) and dark (16 hours) periods, and darkness. For other experimental conditions see Alternaria solani. Striking changes in conidial shape were obtained. Conidia produced by cultures in-

cubated in artificial light of 50 and 100 f.c. were the most nearly characteristic of the species. Colonies subjected to 200, 500, or 1000 f.c. produced conidia which were considerably attenuated and occasionally non-septate. Conidia from colonies incubated in darkness varied from the elongate type found in higher intensity culture incubation to those characteristic of the species produced on host tissue. No variations in conidial shape were induced at temperatures ranging from 15° to 35° C (5-degree increments). The peak of conidial production occurred at the 500-f.c. level. (Johnson, T. W., Jr., and J. E. Halpin, 1954).

Plenodomus destruens. Pycnidia were formed both in darkness and in light. (Leonian, L. H., 1924).

Plenodomus fuscomaculans. Certain cultures were placed in a light-tight cupboard; others were placed in a room in strong diffuse light. At times of strongest light the illuminated cultures were 2 degrees (C) warmer than those in darkness. Those in light formed pycnidia. Those in darkness never formed pycnidia, but mycelial growth was stronger than that of those in light. Sclerotia also formed in darkness. (Coons, G. H., 1916).

Podosporiella verticillate. Light does not appear to be essential for development of synnemata. Synnemata formed in culture are positively phototropic. (Wallace, H. A. H., 1959).

Rhizoctonia carotae. Cultures were grown for 2 months in darkness or in continuous fluorescent light with two blue or red filters. Cultures in the dark produced a thin grayish-yellow mat of mycelium, while cultures under all the light conditions produced, in addition, scattered, sclerotia-like bodies. (Bjornsson, I. P., 1956).

Rhizoctonia solani (Pellicularia filamentosa). Gross differences were evident in the morphology of 96 clones grown in constant fluorescent light and constant darkness. About one-fourth of these produced sclerotia in light but not in darkness. Another quarter produced no sclerotia under either treatment. The remaining half always produced sclerotia, but sclerotial morphology was decidedly different in most cases. In constant light, the sclerotia were more appressed and compact and occurred mostly in clusters nearer the center of the Petri dish. Illuminated cultures showed a distinct tendency toward less aerial mycelium, thinner surface stroma, and lighter pigmentation. (Durbin, R. D., 1959).

Rhizoctonia solani. There was no clear distinction between the quantity of sclerotia produced in periodic light or in continuous darkness. (Townsend, B. B., 1957).

Sclerotium rolfsii. Cultures on a variety of media were given one of the following treatments in a constant-temperature room at 25° C: 1) continuous light (8 f.c. at level of medium outside of culture vessel), 2) continuous darkness except for an exposure of 10 minutes to 8 f.c. after 4 days' growth, 3) continuous darkness but exposed for 1 second after 4 days' growth, and 4) continuous darkness. No significant differences in weights of mycelia occurred under 2), 3), and 4), but 15 to 20 percent more mycelium was produced in continuous light. The dry weight of sclerotia produced by one of the two isolates studied was 30 percent higher in continuous light and four times as many were formed. (Abeygunawardena, D. V. W., and R. K. S. Wood, 1957).

Sclerotium rolfsii. Cultures on potato-dextrose agar kept in darkness showed a thinner, more attenuate mycelium than cultures from the same mycelial source kept in light. Sclerotial initials were formed, but the hard dark mature form of the sclerotia did not develop. Plates that had been kept continuously in darkness for a month without developing sclerotia produced abundant normal-looking and viable sclerotia after 2 days in light. (Clinton, R. K. S., 1957).

Sclerotium rolfsii. The fungus produced few or no sclerotia in the absence of light. In light sclerotia formed abundantly. (McClellan, W. D., H. A. Borthwick, I. Bjornsson, and B. H. Marshall, Jr., 1955).

Sclerotium rolfsii. No clear distinction occurred between the quantity of sclerotia produced in periodic light or in continuous darkness. (Townsend, B. B., 1957).

Scolecotrichum graminis. Irradiation of cultures with ultra-violet light from a Cooper-Hewitt lamp induced sporulation when other methods were unsuccessful. (Braverman, S. W., 1958).

Septoria nodorum. Cultures incubated under continuous light (approximately 100 f. c.) near 20° C produced abundant pycnidia and conidia. Cultures incubated under low light intensities (18° or 24°) produced few or no pycnidia or conidia. (Richards, G. S., 1951).

Sphaeropsis malorum. Cultures on nutrient agar were incubated in a constant-temperature room at 24° C in continuous light, in continuous total darkness, and in 12-hour light-dark cycles under white, blue, green, yellow, and red light of known wave length. In continuous darkness and also in red light in the 12-hour cycle an isolate from apple produced full-sized, apparently mature pycnidia, but no conidia, while another isolate (from quince) produced only small immature pycnidia. Darkness favored the production of microconidia in both isolates. In continuous light in the 12-hour cycle (white or blue light) many pycnidia and conidia were formed in both isolates. Many pycnidia with few conidia were produced under green and yellow light in the 12-hour cycle. (Barnett, H. L., and V. G. Lilly, 1953).

Sphaeropsis malorum. The presence of light strongly favored spore formation in this fungus. (Mohendra, K. R., and M. Mitra, 1930).

Spondylocladium atrovirens. Germ tubes put out by the spores show no phototropic response if light is admitted from a single side but after a time mycelium developing from the spores grows away from the source of light. (Burke, O. D., 1938).

Spondylocladium atrovirens. Formation of the germ tube was not influenced by light, and no reaction to light was observed until the germ tube was a few millimeters long. Then, the tube turned away from the light and subsequent mycelial development occurred on the side of the conidia farthest from the source of light. (Schultz, E. S., 1916).

Stagonospora collapsa. Pycnidia formed in both light and darkness. (Leonian, L. H., 1924).

Stagonospora gigantea. Pycnidia formed in both light and darkness. (Leonian, L. H., 1924).

Stagonospora vitensis. Colonies grown for 15 days on oatmeal agar at 20° C in a light incubator (100 f. c.) produced many pycnidia, whereas parallel cultures in darkness produced only a few. (Cunnell, G. J., 1956).

Stemphylium floridanum. Cultures incubated in darkness produced few spores, while other cultures incubated in the laboratory with supplementary light from a 60-watt incandescent lamp at night showed abundant sporulation without zonation. Cultures growing at room temperature with a normal cycle of daylight illumination produced conidia in conspicuous zones. (Hannon, C. I., and G. F. Weber., 1955).

Stemphylium radicinum. The fungus was grown in darkness and a yellow pigment ($C_{12}H_{12}O_5$) which crystallized in the medium under certain conditions was secreted. (Clarke, D. D., and F. F. Nord, 1953).

Stemphylium solani. Copious production of conidia was obtained when cultures were irradiated with ultra-violet light. Radiant energy of wave lengths 312-546 mμ was primarily involved in the stimulation of conidial formation. (Diener, V. L., 1955).

Stemphylium sp. The fungus was grown at 55° F for 1, 2, or 3 days in light or darkness. A yellow mat of mycelium without spores was produced in continuous darkness and a black mat of spores with a small growth of white mycelium was produced in continuous light. (Bjornsson, I. P., 1956).

Stemphylium sp. The fungus sporulates freely under fluorescent, mazda, or blue light but not under red or far-red (about 7000 Å and above) light or in darkness. (McClellan, W. D., H. A. Borthwick, I. Bjornsson, and B. H. Marshall, 1955).

Stemphylium trifolii. The fungus grows well on common laboratory media. It produces both conidia and sclerotial bodies when exposed to diffused light and primarily sclerotial bodies when kept in darkness. (Graham, J. H., 1957).

Sterigmatocystis nigra. Cultures on Raulin liquid medium were placed near a north window from which they received daylight through various colored filters (discontinuous light). Light had no perceptible influence on the development of conidia. Cultures in light and darkness were essentially the same. (Lendner, A., 1897).

Stigmina platani. Cultures were kept for a month in test tubes of different media in darkness at room temperature. No appreciable difference in growth was noted as compared with growth of cultures kept in diffuse light at room temperature. Few spores formed under either condition. (Apostolides, C. A., 1929).

Trichoderma lignorum. Cultures on nutrient agar were incubated in a constant-temperature room at 25° C in continuous light, in continuous total darkness, and in 12-hour light-dark cycles under white, blue, green, yellow, and red light of known wave length. Many conidia were produced in continuous light, and under white, blue, green, and yellow light in the 12-hour cycles. The effect of continuous total darkness was to delay the formation of conidia and reduce their number. Conidia formed slowly in red light under the 12-hour cycle. (Barnett, H. L., and V. G. Lilly, 1953).

Trichoderma lignorum. Cultures exposed to continuous artificial illumination for 3 days at 25° C showed a more or less even distribution of conidia. Cultures under the same temperature conditions but exposed to alternate light and darkness (12 hours each) produced rings of conidia. No conidia were produced in cultures incubated in continuous darkness. (Lilly, V. G., and H. L. Barnett, 1951).

Trichoderma lignorum. Few conidia developed in cultures grown in darkness but brief exposure to light from a 25-watt incandescent lamp caused profuse sporulation. Repeated experiments gave somewhat varying results, but on the average an exposure of about 1 minute to light of one candle-power intensity suffices to induce sporulation. The violet and blue wave lengths from a mercury lamp were much more effective than the green, but the yellow had no effect. Further experiments with incandescent lamps as light sources indicated that yellow and red were non-stimulating. (Miller, J. J., N. S. Webb, and J. Reid, 1952).

Trichoderma lignorum (ATCC # 8751). Spores were not produced in cultures kept in total darkness until the seventh day after inoculation. A series of cultures was grown in total darkness and then several cultures of the series were subjected to a single 18-hour light treatment (800 f.c.) on successive days after inoculation for a total of 7 days. No spores were produced in darkness. Cultures became sensitive to light on the third day after inoculation with maximum sporulation in cultures which were irradiated on the fourth day. Cultures given light treatment after the fourth day showed a gradually diminishing amount of sporulation. Those grown for 7 days and treated with an 18-hour photoperiod of 800, 400, 150, 60, or 10 f.c. showed a definite depression in mycelial growth. Maximum sporulation occurred at 400 and 150 f.c. Coloration of the medium increased as intensity decreased. A series of cultures was treated with light periods varying from 1 minute to 18 hours at intensities of 800, 400, 150, and 10 f.c. Spores were produced with 18 hours of light at all intensities. No spores were produced in any of the other light conditions. (Wishard, R. H., 1957).

Trichoderma sp. Sporulation but not growth was affected by light. The number of spores increased as a logarithmic function of intensity from 1 to 50 f.c. of white fluorescent light, with time (1 minute) constant. An action spectrum of sporulation showed that the most effective wave lengths were from 4300 to 4900 Å and the wave lengths beyond 5000 Å were ineffective. (Bjornsson, I. P., 1956).

Trichoderma viride. Sporulation of five isolates was strongly stimulated by exposure to light from 40-watt daylight fluorescent lamps, while continuous darkness caused failure of or marked delay in spore formation. Light induced sporulation only during a definite stage in the development of the mycelium. (Gutter, Y., 1957).

Trichothecium roseum. Cultures were exposed to light from Schotts filters in a 12-hour darkness-12-hour light cycle. Zonation occurred at wave lengths between 562 mμ and 860 mμ. The light caused increased conidial production. Light sensitivity could be extended in the red by adding methylene blue to the culture medium. (Sagromsky, H., 1956).

Trichothecium roseum. Cultures all produced significantly larger spores when grown in darkness than when grown in light of approximately 120 f.c. (The light source was daylight fluorescent lamps). (Williams, C. N., 1959).

Vermicularia circinans. Pycnidia formed in both light and darkness. (Leonian, L. H., 1924).

Verticillium albo-atrum. The fungus formed zones not only in constant light but also in constant darkness. Zones appeared at a lower temperature than 25° C only when the Petri dishes were continuously lighted. For cultures on solid media in darkness, zonation is confined to a temperature of about 25°; there is no zonation at 24° or 26°. In light, however, such cultures show zonation at about 23°. (Chaudhuri, H., 1923).

Verticillium albo-atrum. The fungus sporulates freely under fluorescent, mazda, or blue light, but not under red or far-red (about 7000 Å and above) light or in darkness. Abundant microsclerotia are produced under red or far-red or in darkness. (McClellan, W. D., H. A. Borthwick, I. Bjornsson, and B. H. Marshall, Jr., 1955).

Verticillium albo-atrum. The fungus was cultured on Czapek's liquid medium and on nutrient agar. When it was exposed to daylight a pigment which imparted a pink coloration to the whole mycelium was produced. (Pegg, G. F., 1957).

Verticillium intertextum. Colonies grown for 10 days on Dox's solution and subjected to bright sunlight were orange-red in color, those incubated in darkness were white, and those continuously illuminated (60-watt bulb 18 inches from culture plates) were cream-colored. Pigment production ran parallel with increasing light intensity. (Isaac, I., and R. R. Davies, 1955).

Verticillium lateritium. Light, after a period of darkness, stimulated spore production, resulting in zonation in cultures exposed alternately to light and darkness. A noticeable increase in sporulation was produced by an artificial light source of 1500 lux used for a time interval as short as 10 seconds. Violet, blue, and blue-green light stimulated spore production, while colors at the red end of the spectrum did not. (Isaac, I., and G. H. Abraham, 1959).

Verticillium nubilum. Four strains were cultured on a wide variety of media. When they were grown in normal daylight marked zonations of the undersurface were observed as contrasted with the uniformly black undersurface when they were grown in darkness. (Isaac, I., 1953).

Verticillium sp. If the fungus is exposed to a 12-hour light-dark cycle distinct zonation occurs. Alternating areas of numerous and few conidiophores are produced. Growth is almost the same in light as in darkness, but in darkness zones with considerably more conidiophores (darker zones) are produced. Light does not influence mycelial growth, but it does limit the formation of conidiophores. Only wave lengths 350-530 mμ were effective. (Sagromsky, H., 1952b).

Verticillium tricorpus. The fungus was cultured on a wide variety of media. When it was grown in normal daylight marked zonations of the undersurface were observed as contrasted with the uniformly black undersurface when it was grown in darkness. (Isaac, I., 1953).

Volucrispora aurantiaca. Neither coloration nor rate of growth was noticeably affected by light. Cultures grown in complete darkness, normal daylight, and in continuous light showed no noticeable color or growth rate differences. (Haskins, R. H., 1959).

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